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John Bevins M22

APC CONTENTS

Volume 7, Number 12, December 1986

REGULARS

Due to the late inclusion of the Microsoft Works screen test, the full user groups index has been postponed to next month's issue.

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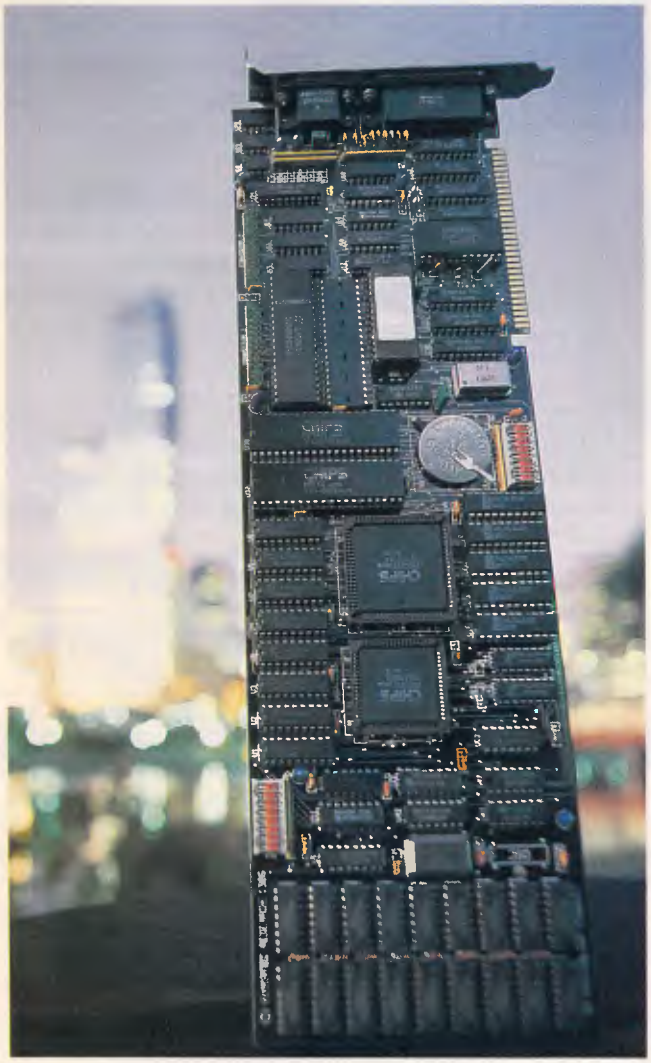

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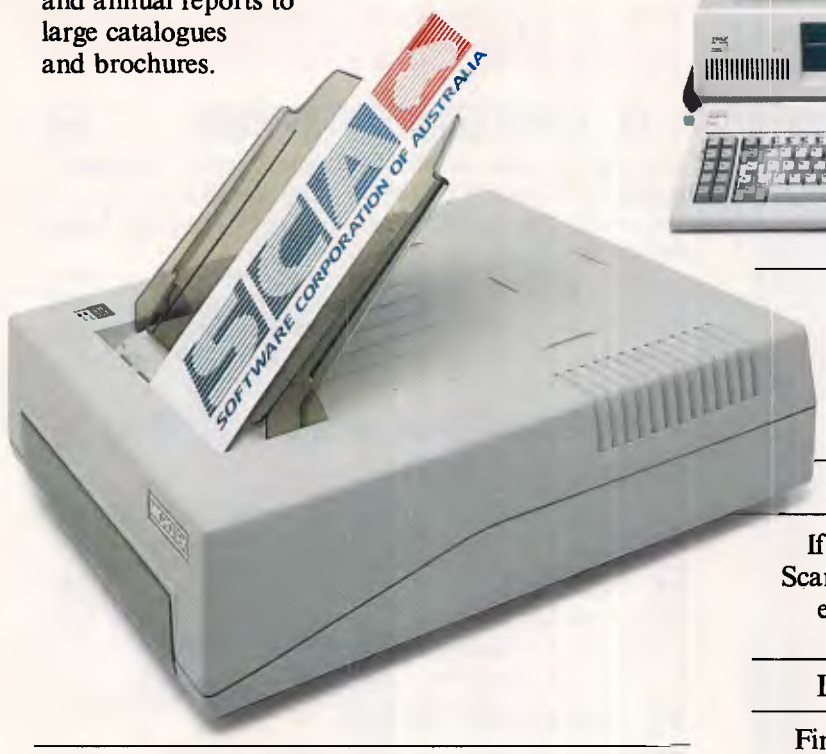

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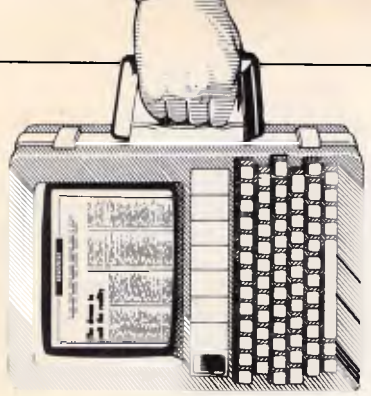


Chendai finds itself in hot water with IBM over alleged copies of its PC Bios, and the betting is on for the product to win IBM's pproval in the desktop publishing area. Just some of this month's news from APC's reporters.

Out foxed

According to IBM, last month well-known PC distributor, Chendai, was giving away more than a free 'First Choice' software package with each PC it sold: it was also pushing out substantial copies of IBM's Bios within its PCs. Naturally IBM is upset. Especially so, as Chendai evidently gave an undertaking earlier this year that it would not infringe IBM's copyright.

So IBM has filed a claim in the Federal court seeking an injunction to prevent Chendai selling its PCs, and is also claiming damages.

Quite probably there'll be feverish late-night activity amongst other importers anxious to determine whether their erstwhile Asian suppliers have 'inadvertently' popped close copies of IBM's Bios into their product range.

Poor old Compaq. Having just announced the vastly expensive 386 range, and now offering this 70Mbyte desktop system, the company has just heard that Intel has produced a $US2,000 plug-in board for existing PC users, which provides the 80386 processor as an upgrade. Admittedly the upgrade won't give you a fast hard disk, but then again, it doesn't cost $16,000 either . . . and fast hard disks can be purchased for less than $2,000 these days.

Hackers Promotional Services Inc.

What are the two things that turn-on hackers most (by 'hackers' the illegal, interventionist type is meant)? Obviously the 'big' thrill is a successful hack, when the hackee's installation succumbs to the every desire of the hacker. And the second biggest thrill? Well, telling everybody how clever they are, of course. But this generally shortens their hacking career, so the best hackers must use more subtle means of publicity. Now a new organisation, Hackwatch, based on the American equivalent of the same name has come to hackers' aid. It should be stated that Hackwatch is vehemently opposed to hacking; its charter is to monitor bulletin boards and other of infamous hackers rorts to warn possible hack-targets of impending penetration.

This is all very good — but Hackwatch has also decided to do something very bad. It is publishing a top-ten' guide to hackers each month! Playing right into their egos, hackers now have a safe, high-profile means of satisfying their second-biggest thrill. All they have to do is perform well enough during the month (at least to out-do others, so big targets will become more popular — you know, stuff like ASIO and Pine Gap).

Hackwatch is a great idea, chaps. But how about canning the bad guy's PR agency side of it?

Microbee about-face

Investors have had their fingers burnt in the first 12 months of Microbee's operation as a public company. The company has reported a loss of $371,000 which is a massive turn-around from its previous year's result of $1.1 million profit, when it was a private company.

Over thirty staff have been sacked following the result and no doubt there must be some serious sole-searching in senior management ranks as to why the firm ever embarked on entering the cut-throat world of importing PC clones — something in which it had previously no experience and seemed to have little relationship to the areas in which Microbee had made its mark, and its fortune. Following the loss announcement, Microbee's share price plummeted from 25c to 18c.

This compares dismally with its 1986 high of 60c.

Atari ST Star Glider

For the first time, there is a convincing reason to buy an Atari ST. It is a game called Star Glider, written by Jeremy San, and it is unique.

It's like a flight simulator, with strange hostile objects floating above the landscape. it's like an adventure game, except the problems are hurtling at you at hundreds of miles an hour. It's like the most enthralling zap 'em-

dead game you ever played, but it also has the greatest graphics. It's . . . it's hard to describe.

Get one, and get an Atari ST to run it on.

Most successful games are designed for the arcades, where kids put coins in expensive hardware. They are re-written for cheap micros, and they are vaguely fun.

Just occasionally, a game arrives, totally new in concept, execution and appearance. Star Glider is the best of these so far.

'Jez' San has been working on Star Glider for 18 months, polishing, improving and perfecting it, to the rage, frustration and panic of all around him who wanted him to finish it.

Unlike any other 'arcade' game, there appears to be no way of simply learning Star Glider and playing it. It's always ahead of you.

Just learning to fly the Air-Ground Attack Vehicle is the first hurdle. Then you gradually learn where to fly it. Finally, you discover where you can re-fuel it, and how. And only then, at the very least a day after you start playing, do you get instructions on what you're trying to achieve. At that point, when you reckon you're getting the game down, it tells you you're rated 'Rookie.' I nearly got into Level Three — really advanced. Gary Scheinwald, who did the documentation, actually *did* get to level three, once. He says there are over 20 levels . . .

As you fly around, shooting and dodging shots, you will see objects appearing on the horizon and approaching you, growing in size smoothly, turning and whirling as they come.

It's not only fast, it's realistic. You find yourself leaning over in your chair, dodging missiles.

Incredibly, the game plays on both monochrome and colour displays. Many Atari games insist that you have one or the other: Star Glider works on either. (You should play it on a mono screen, by the way, because it's more accurate).

As if this weren't enough, the sound includes digitised speech and an advertising jingle of astonishing skill.

Just occasionally, a program comes along that makes a machine sell, in order to run the program. Until Star Glider arrives on the Amiga, it's a water-right reason for buying an Atari.

Star Glider will be available, soon, on the Commodore 64, but will be nowhere near as impressive. And a Macintosh version is also very possible, says the author. *Guy Kewney.*

Theoretically, Advanced DOS 1 (or PC-DOS 5.0 from Microsoft) will do this, and the question is only 'when?', or so Microsoft says.

But industry pundits not only question whether Microsoft will do it on time (middle of 1987) but whether it is capable of doing the work at all, saying that it has yet to launch a working product it wrote itself. This is in reference to the little-publicised fact that Microsoft bought the kernel of MS-DOS, originally, from Seattle Computing and re-wrote it.

The latest rumours from IBM don't point firmly and clearly to a super-micro based on the 386, and undercutting the company's own RISC Technology RT 6150.

Instead, people talk about a product called 'Entry' — based on rumours of a $US400 PC clone, using the 8086 but without expansion slots. That one, my rumour sources say, uses a 3½in, 720k diskette. Or they talk about an $US800 system with 5¼in drives, called 'Renegade', according to the weekly trade paper *PC Business World.*

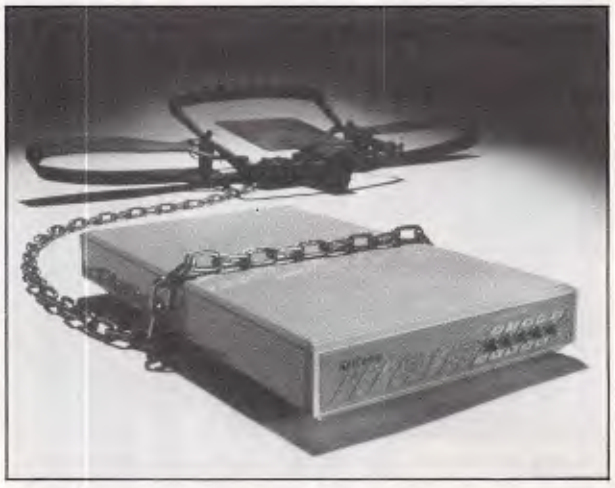
Read all these rumours, if they amuse you. Believe what you like, because the future is an area for faith, not facts.

No-one can tell you for sure which machine IBM will announce, even if they can tell you what it *ought* to announce.

The simple fact is that IBM doesn't make up its mind about launching a product until the day it launches it. There are a great many prototype systems inside IBM, and at astonishingly short notice, many of them can be rushed into production — a good example must be the XT 286. But until they are actually presented to the world, they can be cancelled.

And on several occasions, they have been.

Guy Kewney



NetComm's new Datalock modem operates on a system of automatic password checking followed by an optional redialling sequence. Connection is allowed only after both password and originating telephone number have been verified. For those with communications security problems, NetComm is on (02) 888 5533.

386 still without software

The world is waiting faithfully for IBM to point the way with a new operating system for Intel chips. The shopping list is simple: it must run IBM PC programs in all screen modes, badly-behaved or not. And also, it must use multi-tasking, extended memory and protected memory.

'Secret Agent' memory training

Forgetting someone's name at an inopportune time can be embarrassing — or worse — for the busy executive. Now, MindBank Inc., a US software company, has a computerised system to help even the most absentminded avoid those uncomfortable moments.

Called The Name Game, it combines a computer with a videodisk machine. The machine displays a simulated situation that requires remembering names on a TV screen. Each student plays the role of an undercover agent assigned to attend a party at the US embassy in France. A deadly plot unravels during the evening, but finding the key to the mystery requires knowing the names of all 300 characters present. As each character appears on the screen, students type the appropriate name on the keyboard. If the answer is wrong, the character walks

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away in a huff. If it's right, then the action continues. Slow learners can go to "agent training" for special help. MindBank rents the software needed for both the computer and the videodisk machine for $US595 a month.

A natural upgrade

In past issues of *APC* you've read about the Reduced Instruction Set Computer (RISC) and you've read about Acorn's ARM, a RISC processor. Acorn is following up its BBC Micro with a truly exciting ARM-based machine, and there can't be anyone who hasn't heard that, and who hasn't said, 'Yes, but when?' and changed the subject.

So much attention has focused on that particular development, that a rather more obvious fact has been forgotten.

The fact is: the ARM is a natural upgrade for the 6502 chip.

In a year's time, however, you will start hearing interesting rumours out of Cupertino, California, where Apple has its offices. To Apple, the Acorn RISC Machine is potentially a life-saver.

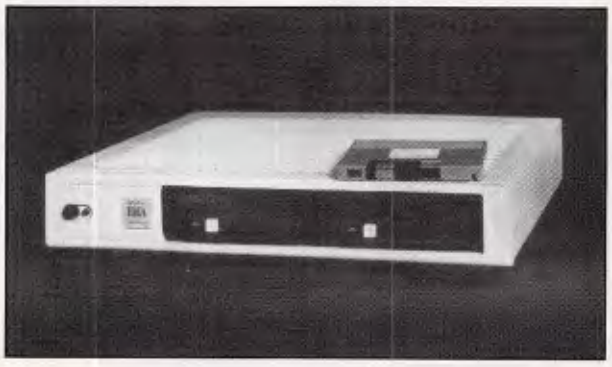
Sales executives at Acorn's Palo Alto (California) research office are already anticipating the future. Ask them if they have had any interest from customers other than Acorn and they say 'Sure! Apple is very interested!'

The ARM was designed by Roger Wilson, described by his peers as 'probably the world's best 6502 programmer'. He was that five years ago, and he's designed the ARM to suit himself. And indeed, the 6502 has many of the characteristics of a reduced instruction set computer (RISC). All the ARM does is many of the same functions in 16-bit and 32-bit chunks, on a 24-bit address bus, and very, very much faster.

Well, of course, Apple may think about the ARM for years and never actually produce a product. But also, Apple may take the obvious step of upgrading its 6502 machine one step further than the GS has gone, by using the ARM.

If that happens, remember, you read it here ... if it doesn't, of course, forget it.

Guy Kewney



This is a removable hard disk device from IDEAssociates, a sizeable US operation which has just set up offices in Australia. Each of the two disks contains 10Mb and the unit has a 'zero' footprint, meaning it sits between the top of your PC and the monitor.

The price isn't cheap (approximately $7000) but then neither are its competitors,' nor for that matter is the technology. Details on Sydney 387 5222 or call toll-free on (008) 25 1247.

The trade pact on chips

The European Community, claiming that Japan and the US have conspired to rig world prices for memory chips, has taken the first step towards challenging the much-ballyhooed semi-conductor trade agreement. Branding the deal a threat to international trade, the EC has asked the Geneva-based General Agreement on Tariffs & Trade (GATT) to force full disclosure of the pact's details, some of which remain secret. The EC fears that the Japanese have promised to set aside a significant share of that country's domestic market for US chips. That would make it far more difficult for European chipmakers to crack the clannish Japanese market.

But the EC is even more worried about the agreement's effects on Europe's electronics industry. European computer makers import two-thirds of their semiconductor needs. Critics charge that the agreement means chips will be less costly in Japan, forcing European companies to either buy chips there and do at least some assembly in Asia or lose market share to cheaper Asian systems. Either way, Europe will lose jobs. European executives favor socking the Japanese with anti-dumping duties and penalties.

Desktop publishing race is on

The 'desktop publishing' product which wins in the IBM market will be the one which gets into the market in the next two months. Increasingly, this looks like being the winner of a race between a new product called Ventura and the Windows-based version of PageMaker.

The reasons for this are simple: Microsoft, as author of Windows, is throwing its full cheer-leading abilities behind PageMaker (the Macintosh brand leader). And rival firm Digital Research, author of GEM, is throwing its authority into the fray on behalf of Ventura.

The fact that Ventura is based on GEM (graphics environment manager) is seen as very exciting at Digital Research. GEM is available on the Atari ST, and a lot of effort is going into desktop publishing on that machine.

Why? Well, the Macintosh has been selling to an increasing extent on its ability to run PageMaker.

The mathematics is simple: a Macintosh requires a $10,000 laser printer, which includes 68000 chip and 2Mbytes of memory, in order to cope with the graphics language PostScript. The new Atari St has 2Mbytes of memory and a 68000 — and a simple, unadorned laser engine can cost under $2,000. Add software costing (say) $1500, and a total DTP (desktop publishing) system costing comfortably under $6000 comes into being.

On a technical base, Ventura should win (in my own opinion) simply because it seems to be more reliable. I have only fiddled with a beta-test version, but it was working a great deal better than PageMaker on the Mac, which tends to crash all the time.

There are other GEM-based products in this area. Archetype's Impression package is one which my sources speak highly of; the only question there is 'when?' and the answer looks like 'not this year'.

The longer it takes to get the product into the market,

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the more chance the rival products have to establish themselves.

APC plans to do a screen test of Ventura in the February 1987 issue. 'Till then, interested parties should call Roger Morgan, Rank Xerox's 'Indirect Marketing Manager' (whatever that is) on (02) 449 0449.

Guy Kewney

AI in Australia

Barry Jones' (Minister for Science) department has undertaken a survey of artificial intelligence research in Australia, and has come up with the conclusion that our AI researchers are 'world class'.

The department's statement continues: "AI is now clearly taken seriously in research institutions, and there is an emerging interest in industry. Most researchers are highly qualified and in senior positions. Most research interest and activity are in expert systems and related areas; this is seen as an area of established capability with commercial potential for Australia within five years.

Other significant areas include speech recognition, vision, computer assisted learning and AI programming languages."

The survey has resulted in the publication of the 'Handbook of Research and Researchers in Artificial Intelligence in Australia'. It provides a reference to who's who in Australian AI, what their research interests are and how to contact them. Readers who would like a copy should contact the Sectoral Policy and Programs Branch, Dept. of Science, PO Box 65, Belconnen, 2616.

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ECS-286

The ECS-286 is an Australian designed and manufactured 80286 based machine claimed to be the worlds' fastest. What a combination — world beating performance and Aussie made.

Oh, what a pity!

From the very peak of elation and teetering cheque book down to the depths of disappointment. It's a long way down.

Imagine it. An Eltham, Victoria based firm making a significant imprint in the highly competitive PC compatible market place by exhibiting, at a US show, a machine willing to take on all comers and capable of reducing every one of them to quivering shadows of their former selves.

This actually happened. The ECS-286 actually held the title of "world's fastest IBM compatible" for a time. That in itself is a terrific achievement, and certainly inspires one to run out and buy one, even if the title has now moved on.

Sure, one would not expect 100 per cent Australian content. It would be reasonable to uncover Taiwanese adaptors, Japanese disk drives, and several other foreign subsystems — after all, there is no such thing as an Aussie 80286.

The machine, among some, carried the stigma of compatibility problems. However, having seen the ECS press releases, this appeared to be because ECS was the typical pathologically honest engineering company. Their release talked about the compatibility problems created by running a fast processor, and the fact that IBM BasicA does not run. These problems are, of course, universal to all high performance compatibles which have not ripped off the IBM ROMs directly. It seemed as though everyone else would have the same compatibility problems, just that everyone else wouldn't talk about them so readily. No great problem. The industry (almost) abounds with great technical companies short on marketing clout, and these can be some of the best to buy from. The classic example of this is DEC.

Sadly, ECS' apparent lack of marketing orientation extends all the way from its press releases through to the design philosophy of its machine.

The machine ECS has created is, in some ways, neither fish nor foul. It's an 80286-based machine which is not an AT compatible.

This may not be such a bad thing, just at the moment. Everyone is buying AT machines and using them simply as fast PCs. Very few exploit the full capabilities of the 80286, apart from its speed. In this respect, an 80286-based PC is nothing to be disappointed about. But, just around the corner lies IBM's ADOS and Microsoft's MS-DOS version 5 operating systems, as well as a host of third party systems which are now becoming AT and 386 specific.

A good number of ports populate the rear of the machine.

Of course, even with these AT specific operating systems, several million PCs will still be hanging around and the industry as a whole will be forced to support them. Although the transition to ATs cannot be made enmasse, the additional facilities available to AT users will gradually persuade more and more people to make the migration. Already, a great percentage of new machine sales is ATs rather than PCs and XTs.

Fully evaluating the seriousness of a non-AT compatible 80286 really requires thinking about where the industry is now, and where it's going in the immediate and long term future. We'll get back to these issues in 'In Perspective'.

For the moment, let's lift the lid and see what makes the ECS-286 tick.

Hardware

The ECS-286 certainly sounds like an AT compatible. The processor is an Intel 80286 running at 12.5MHz with no wait states. This is the clever bit which is responsible for the high performance, as many 80286-based machines require wait states inserted into each memory access cycle. The motherboard includes 640k of dual ported memory.

In a normal configuration, the system includes a 1.2Mbyte high density diskette drive and 37Mbyte hard disk with an average access time of 28 milliseconds. It really does sound like an AT machine. Indeed, these figures would be pretty damn good for an AT and, for an XT, they're simply scorching. The title of 'world's fastest' was obtained in the XT category, which is a bit of a cop out as there are any number of 80286-based

An AT-style keyboard on an XT machine.

machines which could claim a similar title if run up against XTs.

Physically, the machine consists of the traditional 'three box' configuration – display, keyboard and system unit. The system unit is pretty much exactly IBM PC dimensions, although quite a deal heavier. Externally, the front of the system unit sports a small instrument panel providing the AT-style key lock, AT-style power light, and AT-style DASD access light. A half height dual density floppy disk drive is located to the right of the unit, with plenty of room for a second half height device, although not a third. A full height hard disk drive is centrally mounted, with the access LED being extended out to the AT instrument panel.

The power switch is located in the standard IBM position, being on the right hand side of the box, towards the rear, and is of the large red toggle variety. A hidden speaker in the usual left side front position provides the necessary beeps and warbles. The rear of the unit is festooned with ports — two serial and either one or two parallel ports, depending upon the display adaptor chosen. The keyboard socket is located in the centre of the rear panel.

Altogether, the system unit weighs a considerable 20kg.

Stepping inside, the most obvious fact to hit one in the face is the unusual expansion bus. This machine really *is* an XT compatible (or is it an AT with a lobotomy, and general amputation?). To everyone's general bogglement, this machine has an eight bit expansion bus. What's even more incredible, it doesn't have a 16-bit bus (one does not necessarily preclude the other).

The width of a data bus compared to the width of the data paths within a CPU chip gives a good indication of whether or not the processor is running as fast as it might. For example, the original 8088 processor was 16-bits wide internally, but viewed the world in groups of eight bits. This meant that every time a 16-bit quantity was required by the processor, internal interfaces in the 8088 would have to make two eight-bit accesses which would then be joined together. Since memory accesses take a comparatively long time (around one microsecond on the original PC), these gyrations significantly slow down the effective processor speed. The speed penalty only applies where 16-bit manipulations are concerned, for eight-bit accesses, the smaller bus size had no effect. For this reason, the 8086 which used a sixteen-bit external data bus offered vastly better performance, even at the same clock rate. the 80286 processor, naturally, uses a sixteen-bit data bus.

Now, it looks to me as though the ECS-286 employs sixteen bit memory on the motherboard, which is great. But it squeezes everything down to eight-bit chunks through the expansion slots. This would affect things such as display adaptors, disk adapters and expansion memory, causing them all to slow significantly. This may not matter to many users, but prompts the questions *"why?"*.

'. . . the machine looks like an AT, feels like an AT and is priced like an AT.'

In the bad old days, before ATs, manufacturers who used full 16-bit processors generally drove them through eight bit expansion buses. There were exceptions: for example, Olivetti realised that an eight-bit bus would cripple performance, and employed a 8/16-bit expansion bus. Its slots were like a normal XT bus on one end, but included additional connectors on the other end. This allowed normal eight bit cards to be installed while also supporting special 16-bit Olivetti cards. The performance difference could be demonstrated by installing 256k of Olivetti 16-bit memory and 256k of normal eight-bit memory. Programs run in the 16-bit portion ran at the usual M24 pace whereas the same software executing from the eight-bit portion would run up to twice as slowly.

Of course, Olivetti was playing a risky game by inventing its own 16-bit expansion 'standard', as did several other vendors. But most M24 owners filled their machines up with real 16-bit memory from Olivetti, using third party cards for the less critical functions such as communications. After all, memory speed is absolutely crucial to good system performance.

When IBM released the AT, a true 16-bit expansion standard emerged. Now it is possible to purchase third party 16-bit cards for almost any purpose.

The whole point is this. In the old days, manufacturers had no choice but to invent their own 16-bit standard or run with an eight-bit expansion bus. These days, there is no such need. The 16-bit expansion bus is thoroughly established and the industry has now moved on to play the same games with 32-bit buses.

So why cripple a 16 bit machine with an eight-bit bus?

One can only assume that a rather obscure design philosophy was employed, or that the machine was designed a long time ago based on considerations which no longer apply. The implications of this to ECS-286 owners is that high performance peripherals, such as extended memory, will not perform to their full capacity in this machine, and that AT specific expansion cards are totally off limits.

The plot thickens, of course. Not only does the 80286 support a 16-bit data bus for performance reasons, it also includes a 24-bit address bus, thereby being able to address 16Mbytes of memory compared with the normal 1Mbyte for 808X-based computers. Now, since this machine is really an XT, the top four bits of the address bus are not presented through the expansion slots. This means that AT memory expansion cards cannot be used in the machine, and the designers have imposed a 1Mbyte memory limit on a chip capable of 16Mbytes. It could be argued that this doesn't matter, as the unit is sold as an XT compatible. That would be quite true too, as long as people actually buy the machine *as* an XT. However, since the machine looks like an AT, even feels like an AT and is priced like an AT, it would not be too surprising if many owners came to think they actually had an AT.

It should be pointed out, however, that someone buying an ECS-286 *is no*

Specifications

Processor:	80286 running at 12.5MHz with zero wait states
RAM:	640k
ROM:	8k
Keyboard:	Standard AT layout
Mass Storage:	1.2Mbyte AT standard floppy 37Mbyte Winchester with 28 ms average access time
Size:	System unit: 50 x 42 x 15cm
Weight:	20kg
I/O:	Two serial ports; one printer port, eight 8 bit expansion slots
DOS:	MS-DOS 3.1
Software:	GW-Basic

Hardcard™ 20. All other hard disk drives are just...thick.

Hardcard™ from the Plus Development Corporation is faster, smaller and more reliable than any other hard disk drive on a card, in the market today.

It's a breakthrough in PC mass storage design, the original hard disk drive on a PC card.

Only 25.4mm (1") thick, the Hardcard,™ unlike others, really does only occupy one slot in your PC or compatible.

And because of a unique head locking mechanism, Hardcard™ is virtually shockproof, making it the most portable hard disk drive around (now you can take your office with you!).

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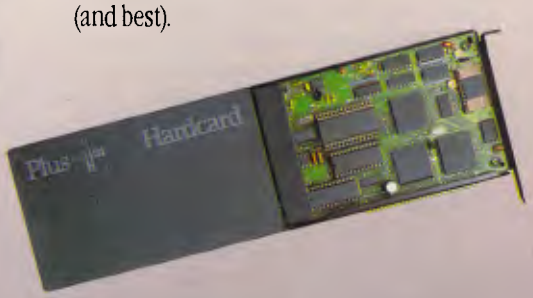
Hardcard™ can be installed (or removed) in minutes and comes with a 12 month warranty. It's the ideal, most affordable way to turn your PC into a PCXT, or for simply adding 20 MByte of hard disk storage.

So now you don't have to sacrifice a floppy disk drive or put another box on your desk to get all the storage space you need, just call Tech Pacific on (03)6909055 or (02)319 2622 for the address of your nearest Hardcard dealer. It's the original (and best).



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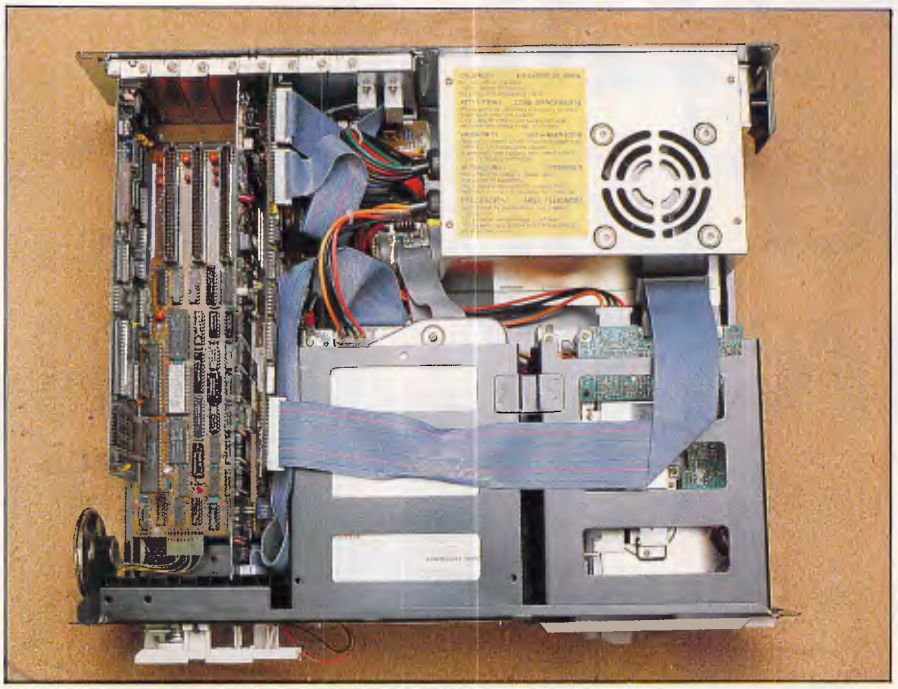

Just visible on the left is the relatively small motherboard.

worse off than people who have installed 80286 go-faster boards in their XTs.

Anyway, after all this discussion of the expansion slots, the ECS-286 includes eight of them, three of which are occupied by standard equipment, leaving five free for extra expansion. The motherboard is quite small for an XT (let alone an AT), and includes an 80286 CPU next to the expansion slots covered with a hefty heat sink. Space for an 80287 numeric coprocessor is provided, and was installed in the review machine. The 80287 is also covered with a heat sink. Also proving that the machine is an XT, only one 8259 programmable interrupt controller is installed, providing eight interrupt levels. AT machines have two of these devices, delivering 16 levels.

The ROM is an 8k job and, I suspect, is also only eight bits wide. The ROM is yet another strange aspect of the machine, as an XT ROM simply will not work in an 80286-based machine. This is because IBM, in its wisdom, employed some Intel reserved interrupts as Bios vectors. When the 80286 was produced, Intel used some of these interrupt numbers to signal various internal events. The 80286 ROM Bios must therefore figure out whether these interrupts were caused by internal events or programmed INT instructions. The AT ROMs do this, as does the ECS-286 ROM. Yet the ECS-286 ROM does not implement the Bios extensions found in an AT ROM. Thus the ROM is partly an AT Bios and partly an XT Bios.

Main memory is 640k, implemented entirely on the motherboard and fully populated upon delivery. The memory is arranged as five banks of 128k, and 90 nanosecond chips are used. This is incredibly fast memory. Most other machines use 150ns or, at best, 100ns chips. The original PC used 250ns devices, and so you can see why 90ns is distinctive. The memory subsystem is sufficiently fast for the processor to run without wait states, which provides a terrific boost to performance.

One and one half switch blocks on the motherboard provide the usual selection of memory size, number of disk drives, display adaptor, numeric coprocessor and factory test settings. The power supply is of the sealed metal box variety, and is capable of delivering 130 Watts of power.

The floppy disk drive is a half height Chinon F-506L, capable of 96 TPI at two speeds. This allows it to handle both 360k and 1.2Mbyte disk formats.

The winchester is a Vertex V130 unit which stores 37Mbytes of data with an average access time of 28 milliseconds. This is also very fast. The IBM AT rates in at 40 ms, and the Compaq 386 only just beats it at 25ms. Normal XTs (and some ATs) employ extremely slow 85ms drives. For any applications which make heavy use of the disk, every extra millisecond you save on each I/O can make an amazing difference to overall throughput. A larger capacity disk is also available, and ECS has done something rather clever to DOS in order to fully support this device, as discussed later.

The drive makes a funny noise when power is applied to the machine. A kind of 'plunk, bounce, bounce, bounce'. The sound is definitely familiar, vaguely reminiscent of a noise which sometimes issues forth from a pin ball machine.

Strangely for a modern machine, the floppy and hard disk controllers are not combined on a single card. One full size card deals with the winchester, and contains an unusually high number of components. Most of the chips are Adaptec, rather than the customary Western Digital VLSI monsters which seem to take care of everything. The Adaptec chips result in a highly complex board – no fewer than 30 ICs plus the customary capacitors, quite a few resistors and a surprisingly high number of diodes. Most surprising of all — transistors! It is becoming extremely rare to see transistors inside computers these days, and this board sports nine of them. Three of the SSI/MSI chips have diodes hand soldered over them, connected directly to the chip pins. These diodes are obviously an afterthought, and would appear to have something to do with power problems, as they seem to be soldered between the Vcc and ground pins. Apart from these flying diodes, the board is bare of 'yellow wire' and so is obviously well established. Possibly the diodes are required due to the unusually fast bus.

The board containing the floppy disk controller is actually a multifunction card. It contains a real time clock calendar with lithium battery backup, single drive controller, one parallel and dual serial ports. One of the serial ports is presented directly on the mounting bracket of the multifunction board. The other serial and the printer port are presented on the rear of the unit, next to the expansion ports, via ribbon cables. The addition of a second floppy drive would involve the installation of a second controller card. The board is generally well engineered with no flying diodes but a heap of 'yellow wire' (well, actually it's white) soldered to the underside. Presumably these revisions will be incorporated into the etching in production models. It is not at all unusual to find yellow wire in early versions, and sometimes even in later production versions of computers.

Various display adapter options are available. Budget users might select a Hercules compatible monochrome graphics card. The review machine was provided with a more interesting configuration of EGA compatible card plus Princeton high resolution colour monitor. The third option is a Verticom M16 graphics controller, a board more suited to CAD applications. The EGA adaptor provided also include a printer port. The Princeton HX-12E monitor was a very

Versatile.

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Multitech is the total solution to your PC needs. From high quality personal computers such as the Multitech Turbo, to peripherals like Sakata monitors and plotters, Super 5 printers, disk drives and modems, Microscience hard disk drives, cables, disks and much, much more.

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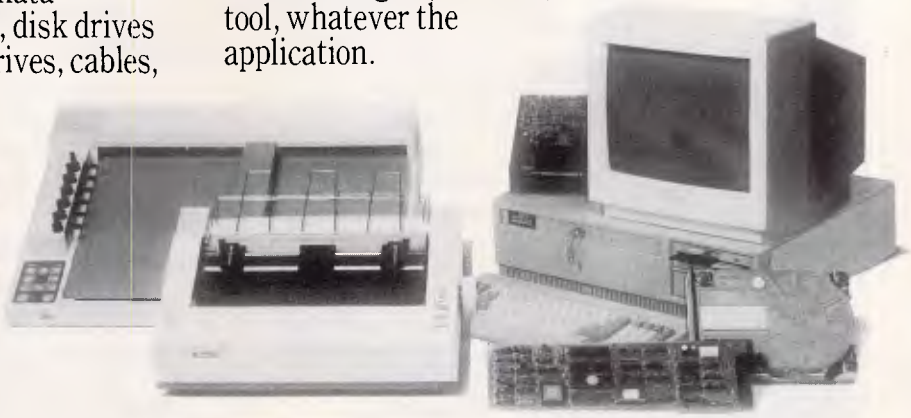

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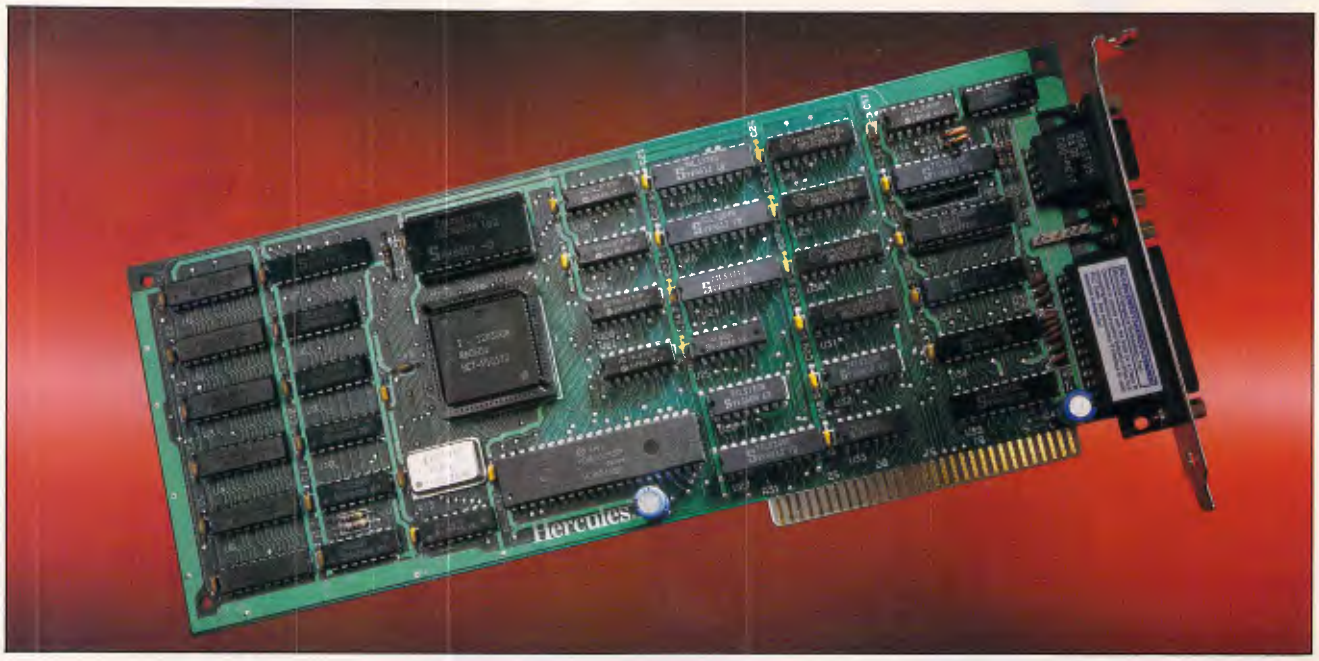


Introducing
The Hercules Graphics Card Plus

It's 100% compatible with our original card and costs 40% less. And that's not even the reason to buy one.

The reason is RamFont, an entirely new mode of operation that is unique to the Graphics Card Plus.

The idea for RamFont first occurred to Hercules co-founder and chief engineer Van Suwannukul, two years ago.

At the time he was working with Microsoft engineers on their new word processor, later known as Microsoft Word.

Microsoft's engineers knew that soon there would be very high resolution laser printers offering multiple typefaces.

VAN SUWANUKUL AND KEVIN JENKINS, CO-FOUNDERS HERCULES

They reasoned that if you could print italics and boldface, you should be able to see italics and boldface on the display.

Unfortunately, the Microsoft engineers were ahead of their time.

It was not possible, with the graphics cards that existed at the time, to get both the flexibility to display multiple typefaces, and the speed that is essential to a word processor.

Van knew that to solve Microsoft's problem, new hardware would be needed.

So he invented RamFont.

Word 3 – Three times faster.

Two years later, the Hercules Graphics Card Plus was ready.

What Van had developed was RamFont, an new mode that could store, and then display at lightning speed, 3072 programmable characters.

By this time, Microsoft's engineers had used every trick in the book to speed up Word, and succeeded in making Word 3 considerably faster than earlier versions.

However, for many users it still wasn't fast enough.

So you can imagine how delighted Microsoft's engineers were when they saw Word 3 running over three times faster on the Hercules Graphics Card Plus.

At last their word processor could really process.

1-2-3 Release 2 fulfills its promise

At Hercules, we knew that this was just the tip of the iceberg. RamFont was a revolution waiting to happen.

The more we used it, the more possibilities opened up.

Take 1-2-3 Release 2 for example.

Release 2 has an optional character set that nearly doubles the size of the viewable spreadsheet.

It's a great idea... until you try scrolling up and down or right and left. It takes forever.

As RamFont has the ability to display characters ranging in size from 8 by 4 to 9 by 16, it was easy to adapt Release 2's smaller characters.

The result is that now you can scroll a far larger spreadsheet as fast as version 1A could scroll a smaller one.

Then another idea occurred to us.

If RamFont could be programmed to display characters, why couldn't it be programmed to display graphics?

Well, it turned out it could.

So we did a bit more work and now you can draw 1-2-3 graphs in a window on top of your spreadsheet, and view your data in the background.

(Or, you can still view a graph on a full screen if you prefer.)

LOTUS 1-2-3 RELEASE 2

We liked what RamFont did for Word and 1-2-3 so much we did the same thing for Symphony and Framework.

Can a graphics card be a work of art?

Van will tell you that the Hercules Graphics Card Plus is the best monochrome graphics card he's ever designed.

Which is significant because 1) Van is not given to exaggeration, and 2) his three previous designs have met with a certain degree of success.

What makes the Graphics Card Plus so good is a chip Van designed called the V112.

The V112 does three things.

First, it runs every single one of the thousands of programs written for the IBM Monochrome Display/Printer Adapter.

Second, it runs every single program written for the famous Hercules 720 × 348 graphics standard.

And third, it makes RamFont possible.

Survival of the fittest

Actually, chips like the V112 do something else. They make our products even more reliable.

One chip manufacturer was astonished when we told him that we test 100% of the nodes on a chip. He said 93% was common.

By testing each chip individually to such high specifications, we are able to weed out weak V112s before they go to assembly.

V112

Then we subject the survivors to more testing at temperatures above 70°C, weeding out whatever weaklings are left.

After the V112 has been thoroughly tested, we insert it into a fully assembled Graphics Card Plus. (Incidentally, all our PC boards are 100% tested, which is another rarity.)

Then batches of the finished product are heated in ovens to greater temperatures than you are ever likely to encounter.

While still hot, the Graphics Card Plus is placed in a PC just like the one you use, and we run special software that exhaustively tests all functions.

Then, as a final precaution, each tested unit is carefully placed in an anti-static bag to protect it during shipment.

Free software, and parallel ports.

Hercules has become famous for the software we include with each monochrome graphics card.

And the Graphics Card Plus has the best software yet.

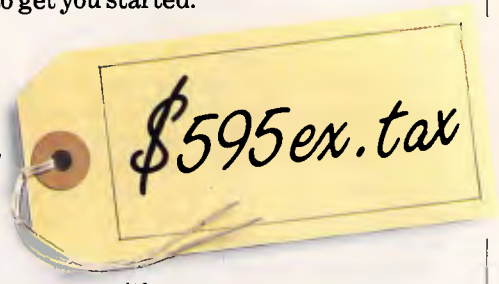
You get a program to extend the life of your monitor.

And to print graphics.

Then Fontman, a program that makes it easy to create your own RamFont characters.

Plus 25 fonts to get you started.

Plus everything you need to run 1-2-3 Release 2, Microsoft Word 3, Symphony 1.1, and Framework II.



And the Graphics Card Plus comes with a parallel printer port that you can disable. (Some PC compatibles require this.)

What price perfection?

With the RamFont breakthrough, 100% compatibility with our original card, free software, a parallel printer port, and the Hercules Graphics Card Plus should cost at least $1200.

Surprise. Its suggested list price is only $595 ex. tax.

If you think that the Graphics Card Plus must be the ultimate monochrome card, you're not alone.

John Dvorak, *PC magazine* columnist, said this about the Graphics Card Plus:

"If you intend to buy an IBM or clone and want to run a monochrome system, this is the card to get. I wouldn't even think about anything else."

Neither would we.

Hercules.
We're strong on graphics.

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large and heavy beast, and provided a good quality display. It can plug directly into the ECS-286 for power, thereby obviating the need for extra power outlets. The only unfortunate aspect of the HX-12E was what seemed to be a regular high tension static discharge within the display. This gentle crack occurred every five to ten seconds during usage, although no significant amount of static was generated on the display surface. The ECS-286 does not remove power from the mains feed the monitor plugs into, and so the user must remember to turn off the monitor after use, just as though it were plugged directly into the mains outlet.

The keyboard is a light weight moulded plastic affair with reasonable tactile feedback and a good long coiled cord and pop-up feet. It is 100 per cent IBM AT layout, further enchancing the impression that one is actually using an AT, rather than an XT. Two small switches on the underside select between PC and AT layouts.

Finally, let's have a look at from where the components come. To be fair, every machine uses foreign components. Japanese disk drives abound, as do American and Japanese chips. Usually, the motherboard marks the nationality of a computer. Looking inside the prerelease model of the ECS-286, we see a Japanese floppy, American winchester, American keyboard, American display made in Taiwan, Japanese power supply, American EGA card, hard disk controller from unknown origins, but certainly not Australia and a motherboard manufactured in America. The multifunciton board is Australian.

This situation will change in later production models, as the motherboard will also be manufactured in Australia. Both the motherboard and multifunction card were designed in Australia. In terms of local content as measured by the government for offset and duty purposes, the ECS-286 rates between 65 per cent and 70 per cent.

In general, the machine is well constructed internally, and is neither above nor below the average standard of internal quality found in modern PCs.

'Apart from these flying diodes, the board is bare of 'yellow wire' and so is obviously well established.'

System software

The ECS-286 is delivered with MS-DOS version 3.1 from Microsoft plus the GW-Basic interpreter.

The DOS seems to have been slightly modified by ECS to better support high capacity drives. A well known limitation in MS-DOS is the maximum size of a disk, essentially caused by two factors. Firstly, all DOS and Bios calls which perform sector reads and writes accept 16 bit quantities and, with a sector size of 512 bytes, implies a maximum volume size of 32Mbytes. Secondly, the File Allocation Table (FAT) which maps out which clusters are used by which files is of a fixed size. Clusters are groups of sectors, and are the minimum amount of disk space which can be allocated or released. In older versions of DOS, there was a limit of 4096 FAT entries which has now been increased to 65,536 entries under DOS 3. A large cluster size (which was required under DOS 2) is very bad for disk efficiency. For example, under DOS 2, a 20Mbyte disk would have a cluster size of 16 sectors. This would mean that, on average, 4k of disk space would be wasted for every file on the disk. Although the increased FAT capacity of DOS 3 helps to make large volumes more efficient, the inherent limit of 65,536 sectors is what imposes the 32Mbyte barrier for DOS.

Bill Gates has developed a recent interest in CD-ROMs, which have capacities far in excess of 32Mbytes (more like 500Mbytes), and has stated Microsoft's intention to remove the 32Mbyte limit from MS-DOS, at least for CD-ROMs, and possibly for magnetic media as well. Traditionally, users with high capacity disks, for example, 80Mbytes, would use the FDISK utility to partition the disk into several volumes each of which is 32Mbytes or smaller, for example, 32, 32, and 16Mbytes.

ECS has provided partially better support for large disks by increasing the physical sector size (transparently to the cluster size). Sector sizes may range up to 4096 bytes on the largest volumes. This means that 65,536 sectors of 4096 bytes can sustain a continuous volume of 256Mbytes. In this configuration, the cluster size could be as low as a single (long) sector, although ECS has actually selected a size of 8k.

This is a pretty sneaky approach, and MS-DOS device drivers take care of mapping the logical 4k sectors MS-DOS deals with down to the 512 byte sectors physically on the disk. By rights, the whole scheme should work very well.

The only problem may occur with disk hacking utilities, and are brought on for historical reasons. Starting with release 2.0, MS-DOS seemed to provide support for sector sizes other than 512 bytes. That is, the BPB (Bios Parameter Block) and other system tables included a field to reflect the sector size, and the manual contained cryptic comments related to these fields. However, any attempt to use a sector size other than 512 bytes would be met by failure. Microsoft

In perspective

Where is the industry going?

Well, the AT has become firmly established and the 8088 is dead, with the 8086 not too far behind it. Software vendors are taking the leap to produce 80286 specific software, further boosting the trend towards AT technology.

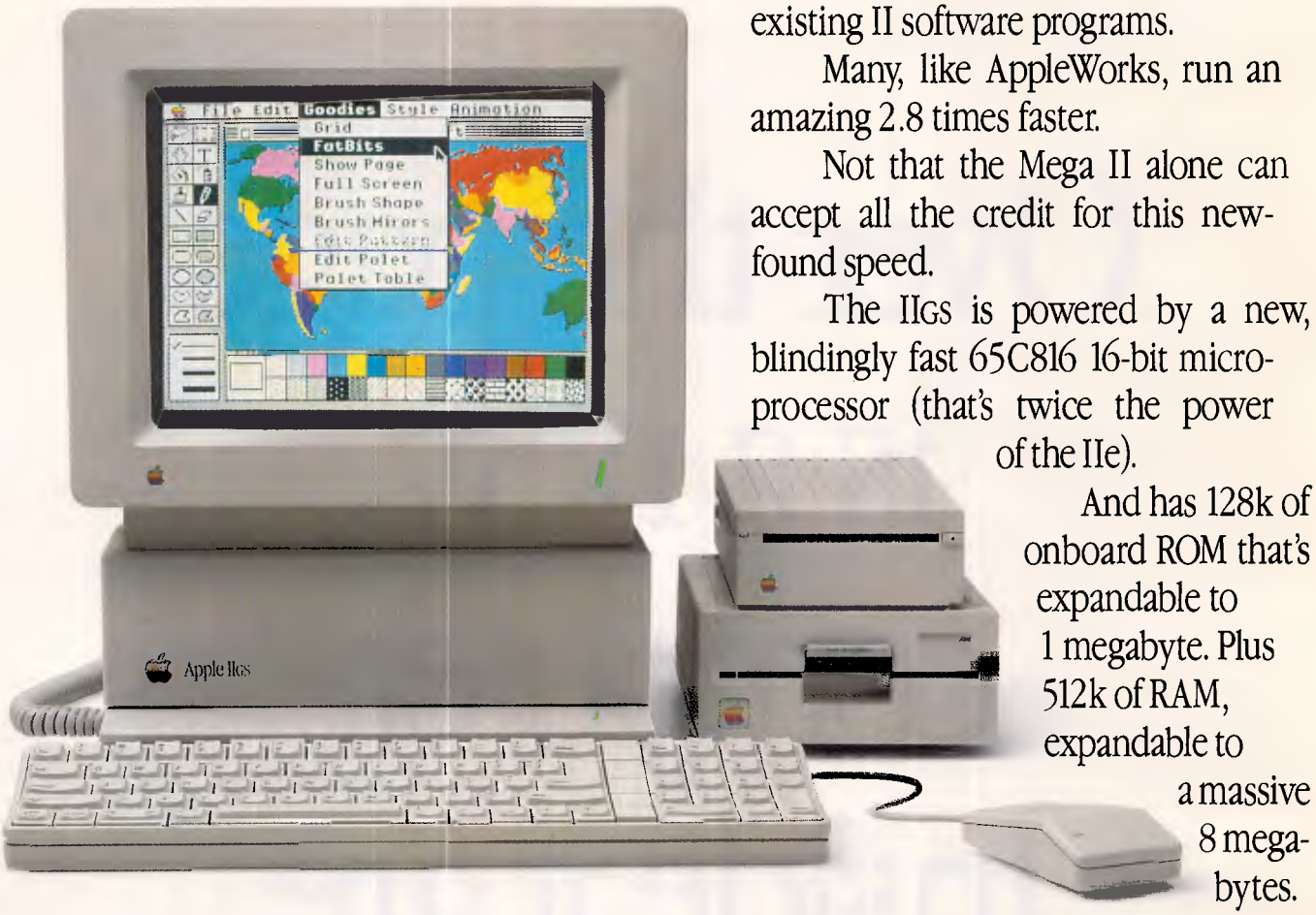
At the same time, the 80386 has burst onto the scene – a super minicomputer on a chip. The industry is going through a familiar set of gyrations, but this time without the assistance of IBM setting a standard. Technical people everywhere are very enamored to the 386. It offers a clear path which will set the industry in good stead until the year 2000. However, the early participants, noticeably Compaq, exist at the pleasure of IBM. Possibly the worst thing IBM could do is not enter the market at all, creating an anarchy among the vendors, with no clean 'standard' upon which machine compatibility can be based. Software vendors are getting right behind the 80386 and respected journals are worrying about whether or not ATs will be around long enough to be fully amortised.

Now, enter an AT which looks like an AT, but is actually an XT. When many buyers are deferring their AT purchases until the 80386 battle becomes a little clearer, how many will leap at the chance to buy an XT at an AT price? The idea of maintaining XT compatibility is, of course, ridiculous. Most AT clones are perfectly compatible with XTs, and subjecting an AT to a lobotomy does not make it any more so. True, an ECS-286 is no worse off than an XT with a go-faster card (possibly a little better), but a go-faster card is comparitively cheap.

Add to this the death knell for any clone, the dreaded spectre of *incompatibility* and the perspective, sadly, becomes all too clear.

Over the page is a new computer. Inside it are two more.

The new Apple IIGS.



The new Apple IIGS features among other things, a built-in Apple IIe and IIc.

Both of these computers, or rather, their functions, have been built into the Mega II chip you see here (and that's its actual size, of course).

Two years in the making, you'll find the revolutionary Apple Mega II microchip alongside many other new custom chips on the IIGS motherboard.

We put it there for one simple reason.

Compatibility.

The IIGS runs virtually all of the 10,000 existing II software programs.

Many, like AppleWorks, run an amazing 2.8 times faster.

Not that the Mega II alone can accept all the credit for this new-found speed.

The IIGS is powered by a new, blindingly fast 65C816 16-bit microprocessor (that's twice the power of the IIe).

And has 128k of onboard ROM that's expandable to 1 megabyte. Plus 512k of RAM, expandable to a massive 8 megabytes.

Which means you can run the most advanced software without running out of memory.

The IIGS was partly named after its graphics, and no wonder.

The IIGS can create graphics as clear and sharp as the photographs you see in this magazine.

But with one major difference.

The range of colours.

The IIGS has 4,096 in all. From delicate violet to electric red.

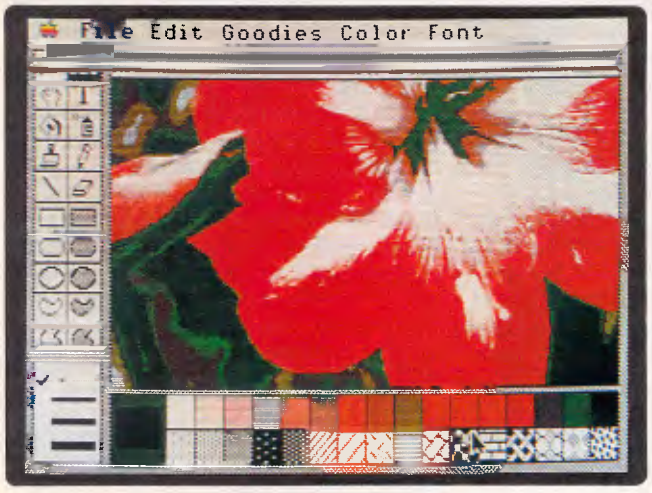
Any 256 can be used at a time in either of two graphic modes: 640 × 200 dots or 320 × 200 dots.

AP320/Palace 2

But you haven't heard anything yet. And we mean that literally.

The IIGS is so human, it even speaks.

The secret is a 32 channel Ensoniq sound chip, the kind you find in $40,000



sound synthesizers (who says Apples aren't value for money?).

It allows you to compose for and play up to 15 instruments at a time.

(Now you know where the other half of its name comes from.)

Naturally, with such high-fidelity sound, it makes sense to add the optional Bose RoomMate hi-fi speakers.

It also made sense to redesign the IIe keyboard to give you maximum freedom.

This one is detached, so you can move it all over your desk.

Or hold it in your lap.

And to make number crunching easier, there's a numeric keypad built in.

The Mouse, now standard, can be attached to either side of the keyboard.

(We didn't want to make left-handers feel left out.)

Also standard on the IIGS is MouseDesk. The software program that gives the IIGS its Macintosh-like interface.

So now, transferring ideas into action is as easy as clicking a button.

And while the IIGS is easy to use, it's just as easy to expand.

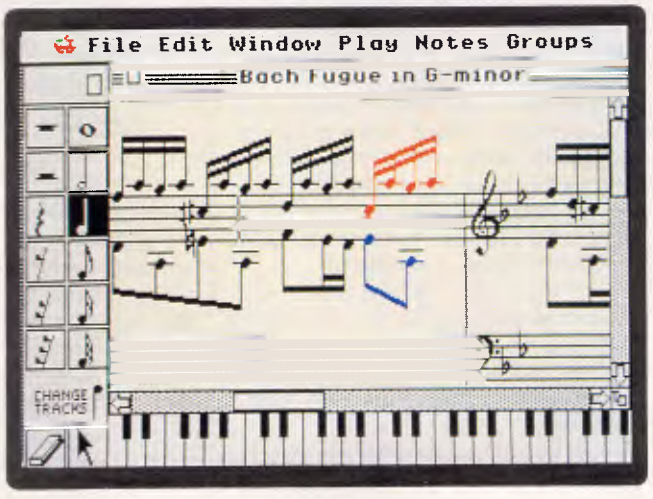
There are eight expansion ports at the back of the machine where you can plug in peripherals.

Anything from disk drives to modems, joysticks to printers.

You can share a LaserWriter with up to 30 other computers, thanks to AppleTalk, built into every IIGS.

Not only can you plug in a cord, you can plug in a card.

Take off the top of the IIGS and you'll find eight expansion slots where once again



it's easy to make the IIGS smarter, faster or more powerful.

As improvements become available, you'll also be able to plug them in. So your IIGS will never become obsolete.

The new Apple IIGS.

It's even greater than the two computers inside it.

Apple

AP320/Palace 3

explained that MS-DOS 2.x actually required sector sizes of exactly 512 bytes, and the ability to accept larger sizes would not appear until a later release. For this reason, all throughout the life of version 2. x (during which the bulk of the software explosion occurred), developers could reasonably safely assume a sector size of 512 bytes. Many utility developers would have hard coded 512 byte sector sizes into their programs. With the release of the AT and DOS 3.x, sector sizes generally remained at 512 bytes, even though they could now have been different, and so all the utilities with 512 bytes hard coded would continue to work.

This should cause absolutely no problems with Lotus, Multimate and most other application software, and does not even cause a problem with the Norton Utilities. However some other utilities, and there are many, may not work correctly on volumes with sector sizes larger than 512 bytes. For example, the 'Disk Explorer' utility hangs with sector sizes other than 512 bytes. Additionally, some of these dubious security systems which write a 'fingerprint' onto the hard disk may have some troubles.

Of course, if you really need to run some software which cannot handle large sector sizes, and if the software vendors do not plan to enhance their product to support the true MS-DOS facilities, then you can always just FDISK the disk into smaller partitions.

Apart from this enhancement, the DOS is a standard version 3.1. It includes EDLIN and the other normal utilities. For users who opted for the Hercules compatible display adaptor, the HGC utility is provided.

The Basic interpreter is Microsoft GW-Basic version 3, and includes several ECS enhancements for foreign language support. This is implemented through the provision of double byte characters which may represent the Kanji, Hanguel and Chinese character sets. Various statements and functions such as ASC, CHR$, DATA, INKEY$ and all input/output facilties have been enhanced, and new facilities such as JIS$, CSNG$, CDBL$ and KLEN$ have been added.

As well as providing foreign language support, ECS-286 owners with unusual scientific or typographical applications should find this feature useful.

Compatibility

Gone are the days when the issue of compatibility used to consume several pages of detailed investigation. These days, just about every clone provides a very high degree of compatibility and the standard problem areas, such as BasicA, are well known and understood. For the reviewer, usually running up two or three of the standard tests provides the expected result that the machine concerned is as compatible as most other machines are. There are usually very few surprises in this area.

Well, unfortunately the ECS-286 has warranted a separate section on compatibility.

Program after program of the standard tests simply failed to run. Indeed, the ECS-286 has been more thoroughly tested for compatibility than most other machines – purely in order to find something which actually runs.

The following software was tested and found not to run: Flight Simulator, Jet, Kings Quest, Night Mission and Gato. These are all games, but provide a reasonable measure of display compatibility, as products such as Windows and many graphics products and WYSIWYG word processors use similar software techniques.

'It is encouraging that an Aussie machine should be able to hold its own among the cream of Taiwanese products.'

In addition to the above, PCPAINT, Microtex Videotex Emulation, Side Kick and Disk Explorer also did not work. On the plus side, Multimate, Print Master and the Norton Utilities ran successfully.

This is quite incredible, and makes the ECS-286 one of the least compatible 'clones' tested here in recent months and years, to the extent that prospective buyers would have to carefully consider the risk involved.

Documentation

Three manuals are provided with the ECS-286, each of which is attractively ring bound in black vinyl.

The GW-Basic manual is the standard Microsoft version 3 work, with an OEM addendum which documents the foreign character set support built into the Basic. The DOS manual is also based around the Microsoft original, although better organised than many. From the back, it includes a large and clear section on EDLIN, a relatively brief section on commands, and an introduction to files and directories. Ahead of this is an introduction for first time users. Spanning about 90 pages, this introduction deals with disk handling, program loading and simple DOS commands. Finally, the front of the manual contains the machine specific section, detailing cover removal, option switches, port addresses, pin connections, Bios calls, keyboard codes and the character set. This is good technical information which is invaluable for any machine.

The third manual is the MS-DOS programmers reference manual. This is of almost no use whatsoever to normal users. However, to anyone doing software development, the manual is an absolute *must*. Moreover, they are not that easy to find, and cost around $80. Thus, for the software developer, the inclusion of this manual is a godsend, and for non-developers, the manual will be eagerly snatched up by programmers for $50 and up.

For owners who select the EGA graphics adaptor, a separate small manual is included.

In general, the documentation is average quality. This is most often the case with clones as the manufacturer can make use of Microsoft materials, and generally does so. The manuals are, however, printed in Australia (except for the EGA manual).

Prices

Well, it's got down to this.

An ECS-286 running at 12.5MHz with floppy, 37Mbyte disk and 640k of memory will cost $9994, including tax. The 80Mbyte disk model is priced at $11,443. The arithmetic coprocessor will add $1150 to the price.

ECS also does a 10.0MHz system, which is more modestly priced at $8012 for 37Mbytes. In both cases, displays and adaptors are extra. For example, the EGA adaptor costs $2294, or you can

Benchmarks

Old:	
BM1	0.17
BM2	0.68
BM3	1.50
BM4	1.70
BM5	1.90
BM6	3.20
BM7	4.90
BM8	5.10
Average	2.39
New:	
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For prospective buyers, it could be a worthwhile exercise to compare these prices with those of other XT machines, and also with one or two ATs.

Conclusion

The ECS-286 is certainly fast — and expensive. Putting to one side the issue of an XT compatible 80286-based computer, and looking at the machine itself, one cannot help but conclude that the box is, in most respects, adequate. There are several machines around with inferior engineering and quality, and similarly there are several which are superior. However, the vast majority of machines on today's market are of about the same calibre as the ECS-286.

It is encouraging that an Aussie machine should be able to hold its own among the cream of Taiwanese products. Well, sort of.

One has to seriously question the Australian content of the machine. Certainly it rates highly according to the government indexes, but internal examination simply does not back it up. It could be argued that the Aussie component is higher than meets the eye due to the R&D outlay, and that the degree of Australian content will increase with time, and that anything is better than buying a Taiwanese, American or Japanese machine and watching the money flood out of the country. And, of course, as far as the eight-bit expansion and 20-bit address buses are concerned, you're really in exactly the same position if you installed an 80286 go-faster card in your PC or XT.

'. . . lots of other ATs could be the world's fastest XT by performing a 'lobotomy'.

These would all be irrefutable arguments, too. Except for the dubious aspect of buying an XT compatible AT in today's market, and the fact that lots of other ATs could be the world's fastest XT by performing a 'lobotomy'.

Now, I'm sure many of us could live with that, after all, it's an Australian machine, and so forth. However, the greatest sin in today's PC industry is that of incompatibility. And sadly, that is a sin the ECS commits. END

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YANKEE DOODLES

Our East Coast correspondent, David Ahl, reminds us of the slow start for erasable optical laser disks and assesses Compaq's move to be first with the 80386 processor.

Out of sight

When optical laser discs first made their appearance 10 years ago, engineers were confident that an erasable version was just around the corner. Ten years later, it still is. Companies in the field, such as 3M, Philips, Kodak, Sony and IBM, have reportedly invested several hundred million dollars in research and have only a few imperfect prototypes to show for it.

Currently, the most promising system is one from 3M that's a hybrid of magnetic and optical disks called magneto-optics. Like pure optical players, a laser and lens hovers above the spinning disk. In addition, a magnet sits below the disk. To record, a high-power writing laser quickly warms a tiny area on the metallic surface of the disk, causing the magnetised molecules to line up with the magnet below. On playback, a low-power laser beam strikes these molecules and is altered slightly as it bounces off the disk. According to 3M, the disk can be written and erased more than 200,000 times.

As the read/write process is rather slow compared with conventional magnetic floppy or hard disks, the system will probably be used mainly for archival and back-up data storage.

The Philips system is much faster than that of 3M; it uses an orderly crystalline material that can be written by a high-power laser which simply melts the crystals in a tiny area on the disk and destroys the orderly arrangement. To erase, the area is reheated and cooled more slowly so it has time to recrystallize.One problem: the material gets brittle after about 1000 write/erase cycles, far fewer than most users require.

Compaq takes the risk

Looking to beat IBM to the punch, Compaq became one of the first manufacturers to introduce a computer based on the Intel 80386 MPU (see *APC* Benchtest, November). The introduction of the Deskpro 386 is a gutsy move for Compaq, since IBM's intentions for using the 80386 are unknown. The move contradicts Compaq's previously successful strategy of following IBM's lead with highly compatible products.

Even more risky is the fact that there is no commercially available software nor operating system that takes advantage of the 80386; hence, at the moment, the only real advantage of the 80386 is its 16MHz speed which makes it considerably faster than other XT or AT machines. Furthermore, the 40Mbyte or 130Mbyte hard disk drives available with the Deskpro 386 are reported to be at least twice as fast as the fastest XT drives.

The Deskpro 386 currently runs a Unix operating system, Microsoft Xenis V/286, and will run Xenix V/386 when it becomes available in early 1987. Both these systems support up to three users. For a single user, the machine also comes with MS-DOS 3.1 which reportedly runs three times faster than on the AT.

In a related announcement, Microsoft indicated that it would not have MS-DOS for the 386 ready for at least 18 months. However, The Software Link Inc, of Atlanta, Georgia, plans to release PC-MOS/386 in February 1987. This operating system is said to behave identically to MS-DOS. It is intended as a single-user system, but it can also be used as a multi-tasking system in either stand-alone or multi-user configurations.

Random bits

Digital Equipment Corp has introduced the VAXmate, an 80286-based machine that can run MS-DOS applications and communicate easily with DEC's VAX line on minicomputers and workstations. the base unit with 1Mbyte of system memory, a single-floppy disk drive and a DEC mouse is priced at $US1945. Options include an expansion unit with a hard disk controller, a half-heigh 20 Mybte hard disk and two expansion slots for $US1945, a 2 Mbyte memory expansion for $US1600, a Hayes-compatible internal modem for $US995, and an installed 80287 maths co-processor for $US500.

New desktop publishing packages were recently announced by a number of hardware and software vendors. Xerox has brought out the Ventura Publisher Edition ($US895) for the PC; it features an interface that allows users to edit, modify and view documents on-screen as they will be printed. Aldus has finally released its PageMaker package for the PC ($US695) as well as Version 2.0 for the Mac ($US495). Bestinfo has introduced a new version of its PC-based Superpage package which, with hardware and software, sells for $US7000. Convergent Technologies, a hardware manufacturer, has released the Office Publishing System which runs on its NGEN Series 286-based workstation ($US7600 complete). In a related move, Layered Inc has announced a Macintosh desktop accessory, Notes for PageMaker, a tutorial on how to use PageMaker, and a primer on graphic design for the non-artist.

Retailers expect that IBM, in the wake of the introduction of its 286-based XT, will de-emphasize the existing PC, XT and AT products as it gets ready to phase them out . . . Zenith Data Systems continues to make inroads into the military with a contract to supply Z-248 PCs to the US Military Academy at West Point, the Naval Academy at Annapolis, and the Air Force Academy at Colorado Springs . . . For people who still don't understand MS-DOS, Microsoft has released a computer-based training package ($US50) called Learning DOS. It has 24 lessons and is aimed at novice and intermediate users . . . MicroPro has released new versions of its word processing packages, WordStar 2000 and Easy, which allow users to directly integrate Lotus 1-2-3 and Symphony spreadsheets into wp documents.

Remember when it was IBM and the 10 little Indians, then IBM and the seven dwarfs, and then IBM and the BUNCH (Burroughs, Univac, NCR, Control Data and Honeywell)? Now, with the Burroughs/Univac merger, the BUNCH loses another member and its only vowel; does anyone have any suggestions what the remaining mainframe industry should be called? END

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Conroy Carpenter TCP 0034

Hypertec EGA

Ian Davies looks at display standards in general, and the EGA standard in particular, with reference to a new Australian card.

"EGA is the way of the future." Despite rumours that IBM is about to can the entire EGA industry, this catch cry would seem to have an element of truth about it. For those who are unaware, the EGA was a major breakthrough in IBM standard PC graphics as, for the first time, a reasonable colour resolution and reasonable text were available on the one screen.

Originally, IBM had two display standards. The main one was the monochrome display adaptor (MDA), capable of very high quality text into very low cost digital monitors. For the first few years, the majority of business machines were equipped with these displays. The big disadvantage was that the MDA was totally incapable of graphics.

'The tracks on the rear weave a web of well designed complexity, without a single flying wire.'

Available at the same time, but not nearly as popular, was the colour graphics adaptor (CGA). This adaptor could produce very low quality text and low to medium quality graphics. Specifically, the text was generated in an 8 x 8 dot matrix, which became extremely difficult to read with prolonged sessions. The graphics modes available included 160 x 100 in 16 colours, 320 x 200 in four colours, and 640 x 200 in two colours (black and white). These graphics modes seem almost carefully selected to be totally inadequate for any intended application.

For example, the 320 x 200 resolution is required to perform videotex emulation, yet only four colours are available in this mode, compared with the required 8 colours.

The 16 colour mode has a resolution so low as to render it almost useless, and the highest resolution mode not only has a funny 3:1 aspect ratio, but also reduces itself to monochrome. And if text work is involved, the CGA becomes a real headache; CAD, text work and business graphics alike all find themselves sadly lacking in a CGA environment. Added to this was the phenomenon of 'snow', a failing in the dual-ported architecture of the CGA which meant that the adaptor and the CPU couldn't really access the same memory at the same time without causing display interference.

The vast majority of business machines are required to perform extensive text work, and so the MDA was the natural choice for many buyers. However, the occasional business graph was also seen to be desirable, and so many systems were sold with both a CGA *and* MDA, for it was one of the saving graces of the IBM scheme that both adaptors could be installed and used at the same time.

It is worthwhile pointing out that the CGA and MDA are two totally separate standards. The display memory is mapped into different locations, different display attributes are appropriate in each, and in general, separate code must be written to deal with each type of adaptor – a real bugbear to software developers.

Sadly, in the early days, a company called Hercules saw a very great opportunity and exploited it very badly. It realised that most business users demanded high quality text, and would also like graphics, but not necessarily in colour. The idea was to implement monochrome graphics through the normal (low cost) IBM mono display. Unfortunately, Hercules came up with a sytem which managed to be incompatible with both the MDA and CGA at the same time. Strangely enough, people bought it, and the software industry found itself faced with a third standard — the dreaded HMDA.

Just a year or so ago, IBM rationalised its display adaptors, and produced the EGA. This was a revolution. Whereas the CGA was designed on the assumption that 16k of RAM was a great deal to be on a display adaptor, the EGA assumed that 256k would be nothing to sneeze at. Moreover, the EGA could provide acceptable text quality while also producing graphics and colour resolutions sufficiently high to be useful.

The only disadvantage to the EGA is its cost. In fact, the EGA card itself is not very expensive in the scheme of things, but the card requires a special high bandwidth monitor, and these cost a small fortune. If you have a cheap Taiwanese PC clone, adding an EGA adaptor and display to it may very well double its cost.

It's rather interesting, looking at EGA board pricing, that IBM has one of the more competitive prices. This is because IBM is one of the few vendors selling a simple EGA card – everyone else is adding second CPUs and expansion memory to try to differentiate themselves from the pack.

Anyway, before long, an organisation called Chips and Technologies fabricated most of the EGA functions into a chip set. Third party manufacturers could now produce EGA clone cards very cost effectively basing the entire board around the C&T chip set. To differentiate the market, vendors started turning their EGAs into multifunction cards, adding second processors, ports, memory, clocks and so on.

In many ways, the C&T chips are analagous to the Motorola 6845 CRT controller found inside the MDA, CGA and HMDA. When compatible manufacturers simply used the 6845, they already had 90% of the compatibility problem solved.

Now we have the situation where just about all of the EGA cards on the market are based on the C&T chip set, and therefore all perform in very similar fashions with high degrees of compatibility. In Australia, it doesn't take ports and clocks to differentiate the market, a "Made in Oz" sticker differentiates it just fine. Nevertheless, Hypertec has produced an Australian made EGA card which, not only is made in Oz, but also includes the clocks and ports one might expect to find in an imported job.

The Hypervid board is also based around the C&T chips, which means that the buyer can have a great deal of confidence that what he is getting, in terms of EGA functionality, is virtually identical to the AST, STB, Techmar and several other brand name boards. Like most of these boards, the Hypervid provides EGA, CGA and MDA adaptor compatibility with 256k of video memory. Added to this is a battery backed clock calendar, parallel printer port, one or two communications ports and a host of utility software.

One of the first things to say about this board is that the chips are not made in Australia. This is hardly surprising. Most of the chips found in American gear aren't made in America, either. The board, however, was fully designed and

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manufactured in Australia, and what a board it is. I'm not sure who appreciates the finer points of these things, but this board is truly delightful to look upon. It is an engineering work of art. Well, maybe that's overstating things a little, but the engineering excellence embodied in the board shapes up well against all international competition. It is well laid out, solidly constructed and features none of the telltale 'yellow wire' and afterthought components typical of low budget productions. This is a really professionally constructed board. The tracks on the rear weave a web of well designed complexity, without a single flying wire.

The board is a full size card, featuring a nine pin 'D' type video socket and RS-232C connector on the mounting bracket. Installation of the optional second serial port is as easy as plugging an 8250 into the socket provided. 512k of video RAM is implemented in two banks of nine located on the far end of the board, with only one bank populated upon delivery. The C&T chips are located centrally, next to the lithium battery. Towards the bracket end of the board are located the serial and parallel components. Two banks of configuration switches are included for selecting various options.

A diskette provided with the board contains a host of vital utilities commonly found with expansion boards these days. The RamDisk utility allows the creation of the ubiquitous memory disk, and print spooler allows background printing while the computer is engaged in other activities. To supplement the print spooler, a separate utility allows the spooler to steal CPU cycles while communications is taking place, intercepting the comms interrupts and letting the spooler get its foot inside the door when they take place. A CLOCK.SYS driver provides a standard interface to the battery backed real time clock/calendar, and a disk cache provides enhanced system performance through a greater degreee of buffering than provided normally by MS-DOS. A VIDEO.SYS driver must be installed prior to normal Hypervid usage.

Just about all of these utilities are presented as CONFIG.SYS drivers and normal .EXE utilities. The .EXE forms allow interactive control and customisation, for example, CACH.EXE provides control over which disk to cache, buffer flush timeout and cache enable. In addition to the .EXE utilities, a pop-up menu can be invoked to manage the spooler.

Documentation provided with the Hypervid is in the form of a small bound booklet, covering hardware installation, software usage, concepts, glossary and system tuning. The manual is generally well written, although a greater use of different fonts, boxes and highlights could make it significantly easier to use. But, considering the fact that most users will refer to the manual once for installation, and never touch it again, the manual quality is probably sufficient.

In terms of compatibility, the Hypertec uses the C&T chip set, and so places itself among good company. Indeed, I have heard that C&T actually incorrectly implemented the EGA standard due to a typesetting error in the IBM documentation and that since so many vendors are based on the C&T chips, the 'standard' has been somewhat unofficially amended around the industry to match what the IBM documentation said, and what the C&T chips actually do. If this is true, then the IBM EGA card is in contradiction of the 'official' IBM 'standard'. Either way, the industry has put itself firmly behind the C&T chips, and by implication, equally behind the Hypertec EGA board.

This is a good board, and a good piece of Australian design, engineering and manufacturing of which we may be proud, and hopefully consumptive.

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NE41 FPC

THE WEST COAST

Tim Bajarin brings you the low down on the very latest developments in microcomputing USA-style. This month he takes the wraps off Ashton-Tate's surprise new package and reveals a way of buying ridiculously cheap software even more cheaply.

Ashton-Tate takes a real shine

For some months now industry watchers have been hearing about a product from Ashton-Tate code- named 'Black Gold'. This product was supposed to challenge Software Publishing's PFS File and give the low-end database market a powerful new entry.

The 27 October announcement of the product, officially named Rapid File, took many by surprise. It turned out to be more of a competitor to Software Publishing's top-end Professional series and Symantec's Q&A.

Priced at $US395, this very nifty program is for users who want versatility and do not need the power of a dedicated dBaseIII type of product. Running in 256k RAM, Rapid File uses virtual memory, and includes a file manager, report writer, memo writer and a way to handle mailing labels. All files are interactive with pull-down menus similar to those of Framework and dBase. The comparable product configuration from Software Publishing would cost you over $US500.

I expect this new product to make a real impact on the products coming from Ashton-Tate's competitors. It should be a real winner for those in business buying low-cost PCs.

Power to PC publishing

Interest is rapidly growing in the desktop publishing world but, at the present time, Apple has made the running in electronic publishing. If you truly need to have text and graphics integrated, then the Apple Macintosh's bit-mapping capabilities allow the best solution today. But since there are so many IBM PCs and compatibles, there is obviously a big demand for desktop publishing software for these machines.

The PC version of Aldus' Pagemaker, already the most popular product on the Mac, runs under Microsoft's Windows application. Aldus has used the Windows approach so that the PC version is almost identical to the Mac version. It is a very powerful package but, like the Mac product, it only allows you to lay out one page at a time. Selling at $US695, it is slated to ship later this month, but my sources say it is more likely to be January.

The product that will probably become the industry's *de facto* standard is Ventura Publisher from Xerox.

Written under digital Research's GEM operating environment, Ventura Publisher looks similar to a Macintosh program.
Nonetheless, company insiders say that they are working on a Microsoft Windows version which will be out under this environment in 1987.

Ventura is different from Aldus' Pagemaker in that it allows you to lay out as many as 50 pages at a time, and it has a running text flow capability that others will try to emulate. It is priced at $US895.

Watch out for both of these products. They will allow the PC world to move quickly to pass the Mac as the main machine for doing desktop publishing.

Boosters for 1-2-3 users

Products that serve as add-ons to Lotus 1-2-3 have been popping up ever since the first Lotus product was released. But, two products deserve special attention. The first HAL, to be published by Lotus, is a natural language front-end query product that sits on top of your Lotus spreadsheet. Once you learn its vocabulary, you can ask questions such as 'What sales territory did the largest dollar volume in 1986?' It's fast, user-friendly and demystifies the use of spreadsheets. This package is a must for new Lotus users as it cuts down the learning time of anyone who wants to use 1-2-3.

The second product, 4 Word, from Turner Hall Publishing, is a powerful word processor that works with your Lotus files and spreadsheet and also sits on top of the main product. Price is not yet fixed.

600 disks going cheaply

It was for both programmers and users that user-supported software, also known as shareware, was developed and made available to the masses.

One of the ways to get these programs is through online services like Compuserve and The Source. If you have the right software communication protocols, you can upload these programs at will and try them out.

Most user-supported software distributors ask for donations of anywhere from $US10 to $US100.

The most successful group to take user-supported software and make it easy to get is PC-Sig based in Sunnyvale, California. PC-Sig is a major pipeline for software programmers wishing to list their products and it sells these programs for around $US6 per disk.

The PC-Sig library contains over 600 disks containing some 10,000 programs;
the entire library is
also available on CD-ROM for $US195.

A new division of PC-Sig called **SIG**nificant software, is about to be formed. This will take many of the programs and bundle them together, giving the user as many as 18 programs for $US19.95.

Look out for the first two products from the company: Trivial Trauma, for older PC users — ages seven and up; and Arcade Mania, which is aimed at even smaller children with access to a PC.

Bottom line microcomputing bargains: only Californian residents need apply!

In California a major trend is developing around the 'flea market' concept. Called the 'North-West Computer Shop', this high-tech swap started originally as a place to sell computer overstock or used products. But these trading forums are rapidly becoming places where even serious computer manufacturers are setting up shop.

Held quarterly in one of three Californian locations, knowledgeable users can walk the floor of this high-tech market and get almost unheard-of bargains. You can buy anything from semiconductor chips, keyboards or monitors to complete PC systems for as little as 20 per cent of their original cost.

At San Jose State University, they offer a 'build you own PC class'. For $US45 you get four hours of instruction, a video tape and a shopping list. Many of these students take their instruction sheets to the computer swap and purchase all they need to make their own PC.

END

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Aussie modems

The Australian modem market could never be called static. As communication with other computers becomes increasingly popular, more devices are being released on to the market to cater for user requirements. Ron Dunn looks at three contenders at the top end of the market.

The increasing number of communications users in Australia has led to rapid developments in local modem technology in recent months. Where once all PC communications were at steady, sometimes reliable 300 baud, it is now becoming more frequent to see communications occurring at 1200, and even 2400 baud. The advantages of this are clear — users are forced to spend less time watching a screen fill with information before they may select actions required, and long-distance telephone charges are considerably less.

Australian modem manufacturers have not been slow in providing quality products to fulfill the requirements of power communications users. This article examines current offerings from three leading-edge companies — Data Bridge, Netcomm and Pulsar. All three modems are capable of communicating under the V21, V22, and V23 protocols, (see communications quick reference guide) and are aimed specifically at the personal computer user prepared to pay for a quality product.

Data Bridge

By the time this article goes to press Data Bridge will have a complete range of modems on the market, offering both fixed and variable baud rate communications. Unfortunately, the only modem it could supply for review was a single speed 1200 baud V22 device called the DSP1200.

This modem has recently been given an Australian Design Award. It offers somewhat futuristic styling, containing an electronics package said to provide a 99 per cent improvement in the quality of communications. This is an interesting claim — while average modems are said to have a 1-in-10,000 error rate, the Data Bridge range is said to only experience one error in 1,000,000 characters.

This claim is based on an improvement to two important characteristics of electronic communications — signal to noise ratio, and signal strength. In both areas the Data Bridge modem is claimed to be superior to others on the market.

Unfortunately this did not show up on our tests. The Data Bridge modem performed no worse, but certainly no better

than the other two tested. Communications were quite good during the test period, leading to a low error occurrence in all modems.

The DSP1200 was tested on Austpac and OTC Minerva, as these were the only reliable sources of V22 communications available on a frequent basis. Purely 1200 baud bulletin boards are not thick on the ground, leading to some test limitations with this device. In all tests it functioned exactly as expected.

Features included with the modem are a good quality manual, Hayes command compatibility, automatic baud rate and parity sensing, and both synchronous and asychronous operations.

Options available for the range include dial-back security and remote configuration—both features that are sure to ensure the modem's penetration into the large corporate environment. BELL standard support is provided as an option for communications with the US.

The Data Bridge modem range should provide adequate communications facilities for advanced PC users, but is expected to sell mostly in the corporate market.

Netcomm 123A

Netcomm offers perhaps the largest range of personal computer modem equipment in Australia, and is continually enhancing its range to support new computers in the marketplace. Recent offerings have included modems for the Apple Macintosh, and an internal modem for one brand of laptop computer.

Almost any configuration of V21, V22, V22bis and V23 communications is available, along with special purpose products for more specialised environments. The model supplied for testing was the 123A—as asychronous modem supporting V21, V22 and V23.

The modem package consists of a very compact and stylish case, a small external power transformer, telephone cable, communications software and user manuals. With the sad exception of a modem cable, this provides the purchaser with all equipment necessary to talk to the outside world. Having gone to so much trouble to make the modem a simple start device, it is a disappointment that Netcomm has not provided this essential piece of equipment, especially given the fear of most users regarding the possible mismatch of communications equipment.

'Australian modem manufacturers have not been slow in providing quality products to fulfill the requirements of power communications users.'

Setting up and using the modem is the essence of simplicity. Simply plug the telephone cable into the wall using the adaptor provided, power up the modem and run the communications package provided.

The Netcomm communications package is written in Turbo Pascal by an Australian software house to support both ASCII and Videotex software. In operation it is much like Crosstalk, even to the command style. A special feature is the availability of additional ROMs for most common screen cards to provide support to the Videotex character set and colour graphics requirements. This aims to overcome the problems experienced with the earlier generation of Videotex programs, in which users were unable to use all features of services such as Viatel due to limitations in their computer.

In summary, the Netcomm 123A is a quality modem, lacking only a computer cable to provide a complete communications package for purchasers.

Pulsar SAM

This modem has the distinction of being the first modem in Australia to be sup-

Communications Quick Reference Guide

The word modem is actually an acronym for the term MODulate/DEModulate. In popular terms it refers to the process of converting a digital data stream from a computer into an analogue signal for transmission over voice oriented telephone lines. The modem takes a binary stream of 1s and 0s representing data in computer form, and converts them to specific tones depending on the communications protocol being used.

The usual communications environment has a computer talking to one modem, talking across a telephone line to another modem, which in turn communicates with another computer. This environment is basically the same in all systems, from the smallest bulletin board to the largest communications networks.

Most modems communicate in either half— or full-duplex mode. This refers to the means by which two-way communication occurs. In a half-duplex environment the communication occurs in one direction at a time, over a single channel. A full-duplex environment allows both computers to talk and listen at the same time.

The standards governing most modem communications in Australia are the CCITT V21, V22, V22bis and V23 protocols. These have been designed to support modem usage within the general switched telephone network, rather than special computer communications lines. The V21 standard supports 300 baud full-duplex sessions. V22 offers 1200 baud full-duplex, while V22bis raises this speed to 2400 baud. The V23 standard is designed to cater for 600 or 1200 baud half-duplex communications. In Australia it is used in 1200 baud form, with a 75 baud back-channel to manage the Viatel system.

Most personal computer modems use the Hayes command set to control their operation through communications software. This is a de-facto standard brought about by Hayes' domination of the early American personal computer modem market, in much the same way that IBM became a standard in the PC marketplace. Hayes instructions control the way in which telephone numbers are dialled and parameters governing the way in which the session is managed once established.

Common features required under this standard are auto-dial, in which the computer will itself dial a telephone number without the need for the operator to intervene; auto-answer, where a computer may answer a telephone and establish a communications session if required; and auto-disconnect, which enables a communications session to be abandoned if instructed by the host computer.

A common port speed is used by many modems today to control the speed of communications between the PC and modem. This allows communications software to be left set at the one speed, with the modem providing baud-rate conversions with the remote computer.

An additional feature becoming popular on modems in the corporate environment is the provision of a call-back facility. This enables the modem to request a password from a user calling the system. The user then hangs up, and if the password is verified will be called back by the modem.

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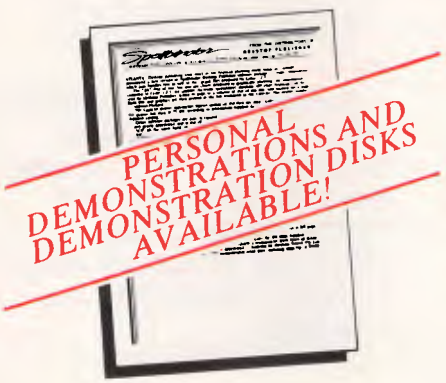
The new Spellbinder Desktop Publisher is much more than just a word processor. Desktop Publisher has the distinct advantage of being able to compose pages, using text as well as graphic images from other programs.

For example, Line, bar and pie charts produced by Lotus 1-2-3 can be read by Desktop Publisher, and scaled to print in any defined area. Other features in the area of graphics include integration of files produced by scanners and paint programs, such as Datacopy and Microsoft PC Paintbrush. This makes it possible to print the output from graphics programs or reproduce custom images, such as your company logo, through Desktop Publisher.

Textwise, Desktop Publisher allows style sheets to be added to a library of style sheets. Unformatted text can be poured into a specific format, page after page. While any document can contain its own style sheet, the separation of text and style allow specific text to be printed in any style simply by choosing one. It also allows text from any source, such as that produced by another word processor or from an on line database to be printed in any style immediately. On any page, exceptions or exclusionary areas can be established for diagrams or graphics. The text will automatically fit itself around those areas. A "what you see is what you get" view on screen is available at a single key stroke. Both text and graphics are then printed in a single pass at the full resolution of 300 dots per inch by the laser printer.

Spellbinder Desktop Publisher is suitable for the IBM PC and compatibles. The program requires a minimum of 256K bytes of RAM and a graphics display card. The new Spellbinder Desktop Publisher is available ex-stock from Software Express. The price is $1,420
(Demonstration programs are available.)



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TAXAN KX1212	$335.00	✗	✓	✗	20 Mhz	18.432 Khz	−10°C to +40°C	6.8 kg	✗	✗	205 mm x 150 mm
ROLAND MA-122	$262.50	✗	✓	✓	20 Mhz	18.432 Khz	0°C to +40°C	7.0 kg	✗	✗	195 mm x 146 mm
QUBIE HR39	$320.00	✓	✓	✗	20 Mhz	18.432 Khz	−10°C to +50°C	9.8 kg	✗	✗	204 mm x 135 mm

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ported by a television advertisement. Admittedly this is the cheap, late-night variety scorned by all but die-hard movie buffs, but even this is evidence of Pulsar's intended market for this device.

SAM offers everything necessary for PC communications, with software for ASCII and Videotex communications being an optional extra. Supplied as standard with the review model were cables between computer and modem, and modem to telephone, and an excellent user manual.

The modem is contained in an overly-large plastic box that is very light weight. I wish the designers had taken a leaf from the Netcomm book and constructed a less bulky package, as space on my desk is at a premium.

The front panel of the modem contains standard lights for communications management, with an additional sequence labelled V21, V22 and V23 — not surprisingly the communications protocols supported by this device. These lights flash in a cyclic pattern until a carrier is detected following a call. At this time they sense the protocol being used at the answer site, and switch on the appropriate light. This is invaluable when calling into sites where the baud rate used is not accurately known, or when trying to test auto-sensing modems.

Like the Netcomm, SAM also contains a speaker that operates up to the point a connection is made with the remote computer. The speaker cuts out when pulse dialling is being performed, but restarts when the other telephone is ringing.

The manual supplied is clear and accurate, although over half is devoted to documenting other products supplied by Pulsar.

Installation is simple, consisting only of cabling the appropriate components. I tested this modem with Crosstalk, PC-Talk and Enable, and found it to operate adequately with each.

In summary, the SAM modem is a well made device that performs well, and only suffers from an awkward and bulky design.

Features	*Data Bridge*	*Netcomm*	*Pulsar*
Model	DSP1234	1234A	SAM
V21	Yes	Yes	Yes
V22	Yes	Yes	Yes
V22bis	Yes	Yes	No
V23	Yes	Yes	Yes
Common port speed	Yes	Yes	Yes
Auto-dial	Yes	Yes	Yes
Auto-answer	Yes	Yes	Yes
Auto-disconnect	Yes	Yes	Yes
Command Set	Hayes	Hayes	Hayes
Dial back security	Available	No	Yes
Telecom approval	Yes	Yes	Yes
Price	$1550	$1651	$862

Fig 1: Models shown here differ slightly from those tested so that modem's specifications are as comparable as possible.

Summary

Each of the modems reviewed performed exactly as documented, and as well, if not better, than I expected. They were easy to install and configure, and performed without a problem.

The features of each device are documented in Fig. 1.

Manuals and packaging for each modem were well thought out, and I would not be surprised to see manufacturers upgrade their respective products to the standard of the other. Even if only public domain software is supplied to manage communications, and only a simple straight cable is provided, this will more than pay off in terms of customer relations.

My personal choice would probably be the Pulsar SAM. While it lacks the compact casing of the Netcomm device, it supplies all necessary hardware and does not require an external power supply. It should be noted, however, that I would be more than satisfied to own any of these devices.

The Data Bridge DSP1200 modem costs $1089 and is available from Data Bridge Electronic Communications. Tel: (03) 578 0814

Netcomm's 123A modem costs $1355 and is available from Netcomm Australia Tel: (02) 888 5533.

The SAM modem costs $862 and is available from Pulsar Electronics Tel: (03) 330 2555.

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- *English keywords are used instead of APL symbols, eliminating the requirements for special keyboard, character generator and printer. DOS files can be structured to be manipulated as a single data item of any dimension or data type.*
- Graphic applications are supported with routines to draw lines, points, polygons, circles, conic sections and manipulation of data to/from screen.
- *Debugging facilities include tracing, stopping, single-stepping, timing and profiling.*
- A demonstration version is available for A$16. The demo version comes with a reference manual and it has a limitation of six global variables. The standard version is priced at A$159 and the 8087 version at A$299. All prices include airmail postage and handling.
- *PL/PC requires an IBM PC or compatibles with at least 360K of memory and DOS 2.11 or higher.*

See quick reference guide
on page 169 of October "APC"

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Translation course

It is now accepted that a thorough study of syntax and grammar is a prerequisite for successful word-to-word translation. David Levy looks at the history and development of automated language translation, with particular reference to the SYSTRAN program.

The first serious suggestions that machine translation might be possible date from as early as the 1930s, but it was not until the advent of the digital computer after the Second World War, that automated translation became a practical possibility. There were some simple experiments in England, starting in 1946, which were mostly on the use of automatic dictionaries, but it was Warren Weaver's seminal memorandum, which he sent to some 200 of his colleagues in 1949, that truly launched the idea of programming a computer to translate text from one natural language to another as a scientific endeavour.

Weaver noted that during the Second World War some of the cryptographic techniques used to decode messages were based on the fact that there are certain properties which are common to all languages. He pointed out that this is hardly surprising, since all languages were invented and developed by man, and that all men, whether Bantu or Greek, Icelandic or Peruvian, have essentially the same vocal and mental abilities to bring to bear on linguistic problems. He admitted there would be substantial semantic difficulties in the translation process, but felt that by using a 'universal language' as an intermediate stage between source and object texts, it might be possible to solve many of the problems inherent in automatic translation.

Weaver had enjoyed considerable experience of early computer design during the war, and because of his interest in languages, it was natural for him to consider the problem of using a computer to translate from one natural language to another. On 4 March 1947, having pondered the idea for a couple of years, he wrote to Professor Norbert Weiner of the MIT, whose book *Cybernetics* remains a classic in the AI literature:

'One thing I wanted to ask you about is this. A most serious problem, for UNESCO and for the constructive and peaceful future of the planet, is the problem of translation, as it unavoidably affects the communication between peoples. Huxley has recently told me that they are appalled by the magnitude and the importance of the translation job.'

When viewed today, Weiner's reply eight weeks later was surprisingly negative:

'... as to the problem of mechanical translation, I frankly am afraid the boundaries of words in different languages are too vague, and the emotional and international connotations are too extensive, to make any quasimechanical translation scheme very hopeful.'

> *'... it was not until the advent of the digital computer ... that automated translation became practical.'*

The first work on mechanical translation that achieved any real publicity was in the form of word-into-word replacement programs. Jokes were made about the lack of understanding of a program which could start with the saying 'Out of sight, out of mind' and produce a translation equivalent to 'Invisible idiot', while another example was a computerised translation from the Hebrew version of the 23rd Psalm into:

'Lord my shepherd no I will lack'

With such evidence becoming rife, it was soon accepted that word-into-word translators could never solve the problems of idiom and ambiguity. These problems are well-illustrated in the following example of a word-by-word translation from German into English of the sentence:

'Paul gibt seiner Schwester einen Apfel'

which has at least 72 possible word-for-word translations:

Paul	gives	of-his	sister a apple
	yields	to-his	nurse an
	renders		one
	emits		
	evolves		
	expresses		

Note that there is no way of deciding whether sister or nurse is the correct translation of Schwester, but this semantic ambiguity might possibly be solved by the use of contextual information: for example, if the program knew that Paul's nurse was in the room but that his sister was not.

Another problem is one of style. It is obvious to us that the translation:

'Paul gives an apple to his sister'

is stylistically correct, while the alternative:

'Paul gives an apple of his sister'

is not, but it is far from trivial for a computer program to produce a translation which is stylistically acceptable.

Soon after Weaver started the ball rolling, a number of American universities commenced translation projects. These early attempts were mainly word-by-word translations, which would print every possible translation of a word if more than one existed. The notion was extremely primitive, but the reasoning at that time was that the output of such a system would be adequate for the reader who merely wanted to know the gist of an article written in a foreign publication. It was presumed that the reader's own general knowledge of the subject would make it possible to elucidate any obscure points in the 'translation'. Word-by-word translations were too crude and lacking in quality to be of any value, and it was not long before it was recognised that some kind of syntactic analyser was needed.

Problems

In 1954 a research team at Georgetown University in Washington DC set up a public demonstration to show that machine translation was possible. Using a vocabulary of only 250 Russian words, only six rules of grammar and a carefully selected sample of easy Russian

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sentences, the system could not be said to have enjoyed any scientific credence, but it did serve to convince the public that automatic translation was already a reality. The 'success' of such a simple system ought to encourage readers who are interested in this field to write their own programs.

The Georgetown system became one of the most significant developments of the era in machine translation. The program was written and tested on one text, amended and used on another larger text, then amended again, and so on. The end result was an enormous program of great complexity, and as the system became more and more complex, it also became more and more difficult for the programmers to modify.

During the decade from the mid 1950s to the mid '60s, automatic translation research in the USA was supported with almost $20 million of funding, and that was in the days when $20 million was worth having. But instead of the hoped-for breakthroughs, the AI world saw only poor-quality translations and more and more linguistic problems. Just as the optimists among the computer chess fraternity had wrongly predicted Grandmaster level programs within a decade, so their counterparts in automatic translation had prophesied commercially available systems within five years, only to be equally disappointed.

I believe that one of the philosophical problems which retarded progress in this field was an overwhelming belief that perfection was the goal. In fact a far from perfect translation can be extremely useful, but when, in 1966, the National Science Foundation in the USA set up a committee called ALPAC (Automatic Language Processing Advisory Committee), it reported that computerised translation was slower, less accurate and twice as expensive as human translation. The committee stuck its collective head firmly in the sand and recommended no further investment of government funds in the field, so for a while machine translation research in the USA went into decline.

'The Georgetown system became one of the most significant developments of the era in machine translation.'

Up to the mid-1960s, the direct translation' approach was prevalent in machine translation systems. This approach assumed that the vocabulary and syntax of the source language text should be analysed only sufficiently to resolve ambiguities, to identify appropriate translations and to determine the word order of the target language text. It had already been established that methods of syntactic analysis could be greatly improved with the help of linguistic theory, but at the time, syntactic analysis was used merely to recognise word classes (nouns, verbs, adjectives, and so on) in order to deal with situations where the same word could be construed as being a noun or a verb. Semantic analysis was rare, and used only in the case where contextual information could resolve ambiguities, and the leading researchers in the field had grave doubts that semantic problems would ever be completely resolved.

The 1966 ALPAC report resulted in a reduced effort being placed on machine translation systems. Goals became more realistic — translations were no longer expected to be stylistically perfect: rather, they were intended to bear a faithful resemblance in meaning to the original and to be readable. Those investigating machine translation came to the conclusion that short-cuts were not appropriate to such a complex task, and that only a thorough study of the

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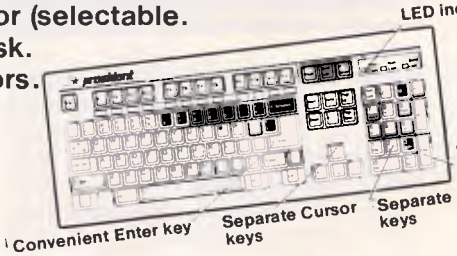

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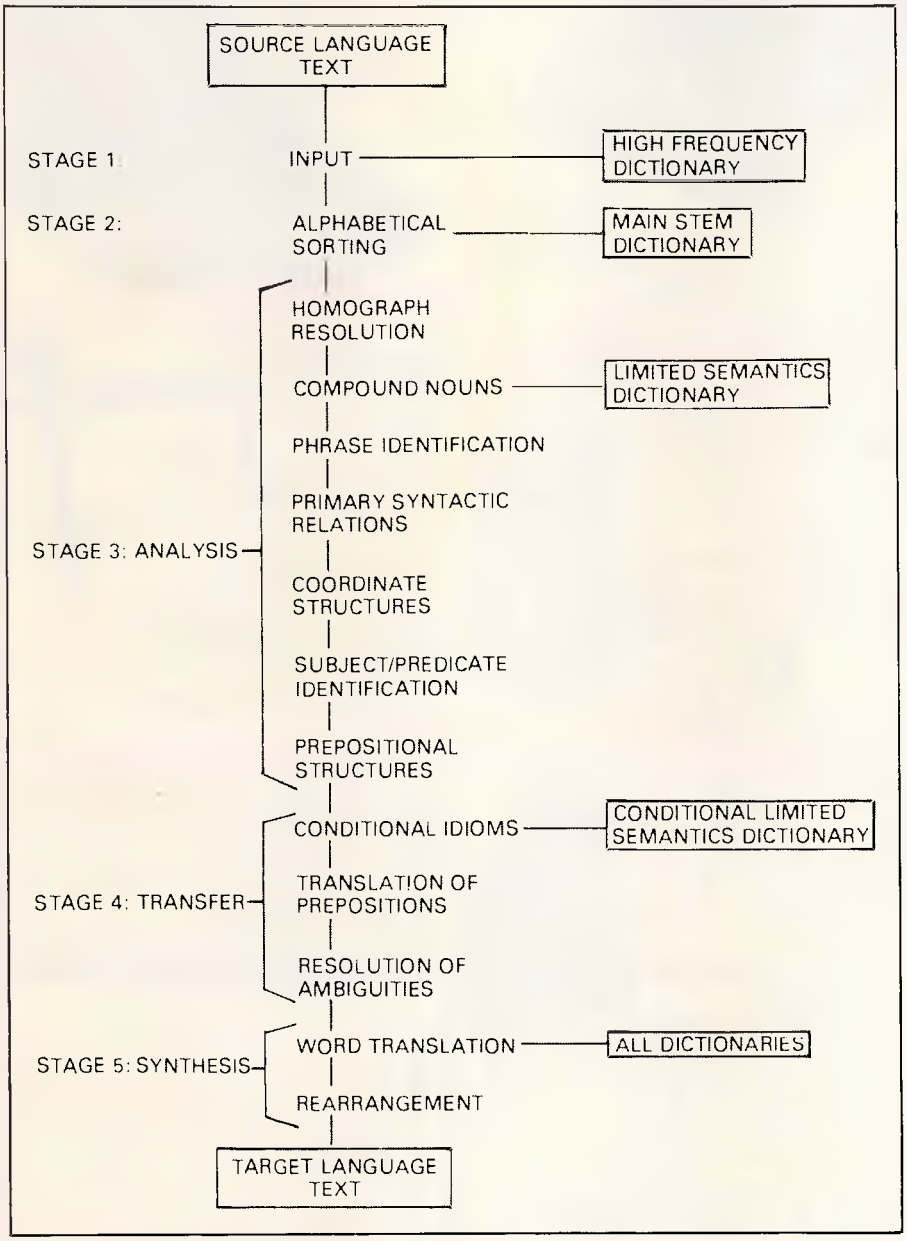
fundamental problems of syntax and grammar would lead to high-quality translations.

Breakthrough

After a relative hiatus of a few years, as a result of the negative influence of the ALPAC report, the work on direct translation systems continued. One of the best known of these is SYSTRAN, which was originally designed by the US Air Force at Dayton, Ohio, to translate scientific texts from Russian into English. Research on the project commenced in 1967, and within three years it was in service. The system is sufficiently flexible to be extended for use with other languages, and it has been shown to work from French into English. SYSTRAN represents a great improvement on the basic direct translation system, and serves as an excellent example of how modern computerised translation systems work.

The SYSTRAN program functions in five distinct stages. The first stage is the input program which loads the text and the dictionaries into memory and checks each word in the text against a 'high-frequency' dictionary. The main dictionaries have 168,000 stem forms, and almost 6000 different idioms. The high-frequency dictionary contains the most frequently occurring words, and being relatively small, its purpose is to speed up the process by which the program locates the translations for many of the words in the source text.



Flow chart of the five stages of translation of SYSTRAN

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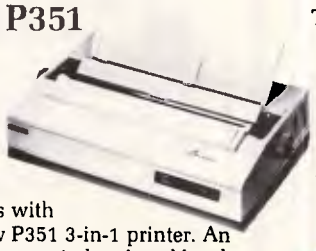

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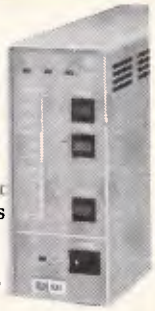

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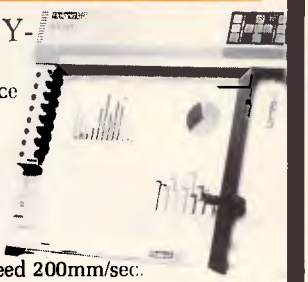

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In the second stage of the translation process the remaining (untranslated) words in the source text are sorted alphabetically and searched for in the main dictionary. Both of these dictionaries provide a certain amount of grammatical information about the words, as well as some semantic data and a list of possible equivalents in the target language.

Next comes the analysis program, which makes seven passes through each sentence in the source text:

- (1) To resolve homographs (words that have the same spelling but different meanings), by examining the grammatical categories of adjacent words;
- (2) To look for compound nouns (for example, tennis court) in a 'limited semantics' dictionary;
- (3) To identify phrase groups by looking for punctuation marks, conjunctions, relative pronouns, and so on;
- (4) To recognise fundamental syntactic relations;
- (5) To identify coordinate structures within phrases: for example, nouns modifying other nouns;
- (6) To identify subjects and predicates; and
- (7) To recognise prepositional structures.

The fourth stage is the transfer program which has three major functions:

- (1) To find words that have idiomatic translations under certain conditions: for example, verbs which have one translation when used actively, but a different, idiomatic translation when in the passive form (he plastered the wall — he was plastered);
- (2) To translate prepositions with the knowledge gleaned from semantic information within the text; and
- (3) To resolve any remaining ambiguities, usually accomplished by applying special tests that are specified in the dictionaries for particular words or expressions.

The final stage of the process consists of producing stylistically acceptable sentences in the target language. This often requires modification of certain word forms and changing the word order. The quality of the translations produced by SYSTRAN can be judged from the fact that 52 per cent of the translations were acceptable without any further editing. Approximately one-fifth of the remaining texts were acceptable for individual users, but required some editing before being publishable.

The programs and their dictionaries required 450k on an IBM 360/65 mainframe, which is equivalent to considerably less than the smallest hard disk available on the average PC, and SYSTRAN could cope with approximately 350,000 words per hour of CPU time. This suggests that writing a translation program, even one which could be commercially useful, is well within the bounds of possibility for programmers with a disk-based computer at their elbow.

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QUBIE

True spirit

Martin Banks narrates a cautionary tale about Christmas past, present and future.

Well, Christmas is nearly upon us once again and the kids are getting excited because parent persons are considering ... just considering, mind ... whether they might indulge in a personal computer this year.

It's a difficult problem for them. Maybe they missed out on the last rounds of Christmas techno-gluttony, when parents from every part of this festered isle seemed to rush out and buy their offspring a VZ-300 or a Commodore 64 or a whatever, only to find that in a reasonably high percentage of cases it didn't fulfil the parental dream.

Instead of intently learning *all* about computers, getting jobs as chief programmers with software companies and getting a Ferrari they were too young and inexperienced to drive (a particular dream of the yuppy parent, who might then get the chance to drive the thing themselves), most kids simply learned how to zap space invaders of one race, colour, and dubious religious persuasion in a bloodless orgy of commuted violence.

If not that, the luckless Christmas present found its way into the back of a cupboard, there to remain until discovered, many centuries later, by ardent anthropologists who would set out to prove that the find marked the emergence, or breakdown, of 'civilisation'.

Some lucky machines would be given some useful status in the home, propping up the short leg of the kitchen table, for instance.

All that was in the old days, however. Now the parent persons have a justifiable reason to rush out and buy a personal computer for the family, a reason of their own. The emergence of IBM PC compatibles as cheap as the Amstrad PC1512 brings them the industry standard desktop marriage of person and machine at a price which makes it attractive for the home user.

It has all the bits needed; PC compatibility (well, at the time of writing this, the first doubts about how *total* that compatibility is have already started to appear ... needless to say, it is unlikely to prove as compatible as most others). It is also generating a new splurge of cheap applications software spun off the back of old, usually fairly well-proven, packages. Best of all, it is not expensive.

This, for the individual home user, is not quite the same thing as being cheap. At $1450 for the lowest-cost single disk version, it is still a goodly lump of disposable income. This is not the whole price story, either, for most users are going to want a printer, and even a cheap one adds to the price. Also, any half-serious user will soon appreciate that a dual-disk version is a much better option, so once again the real price will go up.

Despite all this, it still represents what marketing executives love to call an 'aggressive price position relative to the competition'. That competition has, until now, had its sights firmly set on the business side of the IBM PC-compatible market-place. That, after all, has been where virtually all the sales have been. One of the key levers that could bring the Amstrad machine into the home in large numbers this Christmas, is the fact that there are now many people using PCs at work.

Having PC at home as well could prove to be very helpful in the parents' working lives, making them able to do something creative/essential/demanded-of-them-by-their-boss in their own time. It could also go a bundle in the self-esteem battles with the neighbours ... 'Still trying to do consolidated accounts on that?' you could say to a neighbour, as you disdainfully stare down at a tarted-up games machine.

But hereby lies a potential problem for Amstrad in getting the PC1512 into homes. Alternatively, it could spell a problem for lots of computer manufacturers, IBM being not least among them.

The nature of the problem is in the existing systems used by many companies (and therefore many potentially Amstrad-buying parents). The growth in the clone market generally has cut IBM to the quick, and there is a general consensus that the company is now going to do its best to move the business/corporate PC market-place to new machines, probably of a more proprietary nature.

There is much less consensus as to what these new machines might be like; whether they will be based on Intel's new 386 processor, the existing 286 processor with new, proprietary software, or the RISC-based RT/PC line. It could move in any or all of these directions, and probably will, fairly soon.

The next question, however, is whether those corporate users will actually play the game and follow the new tracks being set out for them by IBM, and some other manufacturers as well. To be sure, some of them will.

Some will be IBM houses right across the board, in which case a move to new machines (that will almost certainly include integral facilities for micro-and-mainframe communications) will be natural and essential. Others will be DEC-based establishments, in which case the new VAXmate MS-DOS machine will attract, as it gives them the growth path they would like between the PC environment and the overall VAX environment.

For executives in these companies, they may find that the idea of having a PC at home could be severely prejudiced by its potential incompatibility with what the company is now going to use. This, in turn, could adversely affect the demand for cheap clones in the home market.

On the other hand, there could be growing instances of what I have in the past referred to as FIRN: Functional Inertia Response Neurosis. This can come in many forms, including the classic: 'Wait until the price drops low enough to buy, and then when it does, find that a later model has more interesting features that you are willing to wait for until the price drops low enough' (repeat endlessly until the technology is no longer relevant).

Another form, however, is where existing users just get fed up with all the changes foisted on them by the industry. In this case they simply refuse to buy, partly because they don't yet understand the capabilities of the systems they already have, and partly because they haven't yet used up their machines' applicability.

In this case, they will stick with what they know — the PC. The big companies will get egg on their collective faces and the clone makers . . . well, they could sell heavily not only into the home, but business as well. Next year should be fun.

END

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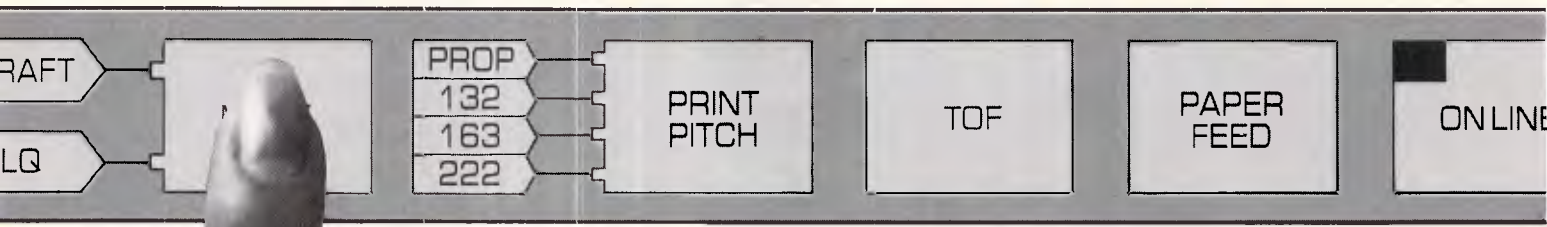

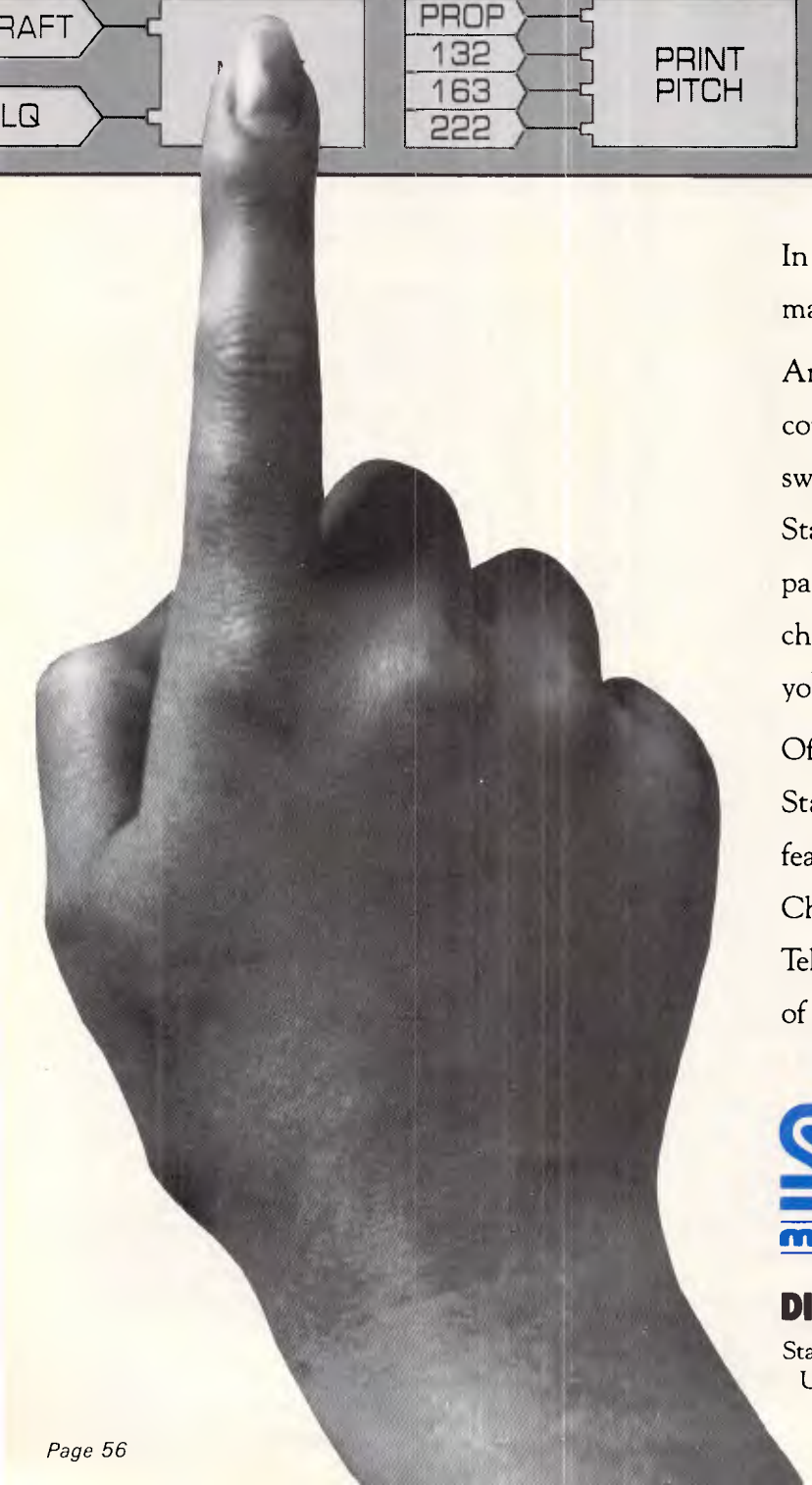

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XL

Kester Cranswick looks at XL, a new Australian fifth generation language, and X-TRACT, the first expert system development written under XL

If you are a shrewd investor, you may have heard of Intelligent Systems Research. A few months ago it issued a million 20¢ shares on the second board of the Brisbane stock exchange. In October, those shares rocketed from 20¢ to a peak of $3.10, largely due to speculation about a product ISR had announced to the market. The product was a fifth generation language called XL, and an interpretive environment written in XL called X-TRACT.

XL is defined by the company as "a technologically advanced fifth generation language that utilises artificial intelligence techniques for the purpose of building expert systems," — a tall claim indeed. It runs under Unix, on a range of hardware from the AT&T 3B2 to the IBM PC/RT. Already, tertiary institutions such as Chisholm Institute of Technology and Royal Melbourne Institute of Technology have, with Victorian government backing, established week-long courses to teach X-TRACT to programmers and system builders. IBM has showcased X-TRACT during its recent PC/RT Roadshow. The future looks bright indeed for this Australian-made product.

XL requires the Unix operating system V.7.Sys III or above to run, and is currently ported to super minicomputers such as the AT&T 3B2, NCR Tower and the IBM PC/RT, under Xenix. For $75,000, developers can purchase XL, the X-TRACT environment, reference manuals, the two shells, with documentation and the compiler, X-ELERATE. By the second quarter of 1987, ISR hopes to be selling stand alone, compiled, ready-developed expert applications, written in C, for any machine from a PC to an IBM 3090, priced from $1,000.

ISR was initially founded as a subsidiary of Multisource International (MSI), an Australian company distributing various computer software products. MSI also dealt in peripherals, microrobotics, graphics and imaging systems. In 1982 it set up a research project called Intelligent Systems Research, to develop a language that could be used for expert systems. In 1984, ISR commenced trading and demonstrated the first prototype of XL.

ISR was incorporated in early 1985, but money was needed to fund further research. So in October 1985, an MIC, Techniche Limited, injected substantial funds, the rights to XL were purchased from MXI. X-TRACT was completed by May, 1986, and in the next month ISR acquired the systems engineering division of MSI. ISR went public in August this year.

Expert systems

Expert systems are not new. They are a spin-off from research into artificial intelligence. Their purpose is to solve problems, in a manner akin to the way humans do.

Computers are very good at solving problems involving the manipulation of numbers. They are excellent at handling precise quantities, rapidly and accurately, through the use of logic. That's why they are so commonly applied to financial forecasting and analysis. They can also handle fixed data very well, hence their usefulness in such fields as word processing.

But, give a computer a judgemental problem to solve and it will run into big problems. We humans are able to evaluate data based on probabilities, guesswork, informed opinion and gut feeling. The means to work out things such as "which route should I take to get to Geelong?" and "what is wrong with this car?" are what is termed heuristic means. We use an intuitive, trial and error approach to problem solving, often backed up by expert knowledge of the factors affecting a problem.

An expert system is therefore a computer application that attempts to solve problems in a human fashion. A commonly quoted definition of an expert system was written by Stefik, in the journal 'Artificial Intelligence', in 1982. "Expert systems are problem solving programs that solve substantial problems generally considered as being difficult and requiring expertise. They are called knowledge-based because their performance depends critically on the use of facts and heuristics used by experts," he wrote.

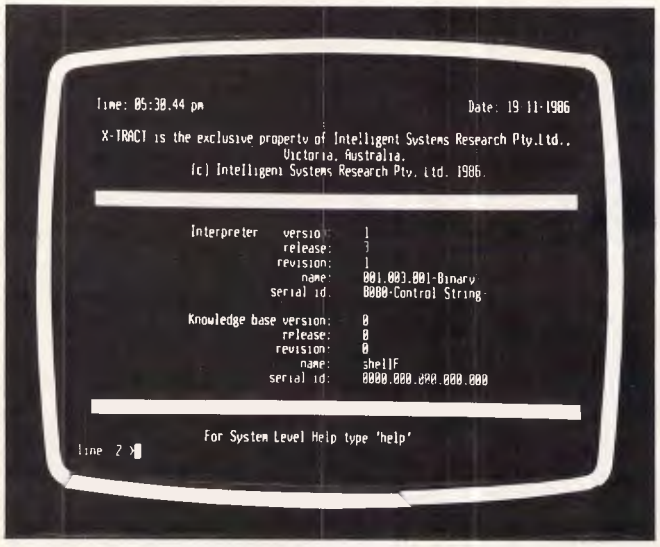
An expert system might therefore be called on to provide a preliminary diagnosis of a patient, analyse geological data in the search for oil, solve taxation queries or work out which insurance premiums to apply.

XL is not in itself an expert system. It is a language for the development of expert systems. There are two types of programming languages – procedural or flow-directed languages, and data-directed languages. Precedural languages execute their commands in a sequence determined by the programmer. Basic is a procedural language.

Data-directed languages are more radical. Their execution is dictated by the state of the database they refer to. If the database has certain characteristics, certain commands are executed. It means that system developers can work in a procedural manner if they wish, and then switch to data-directed routines that use the inference engine. In effect, this means that a programmer need not be concerned with the layout of a program. Providing all commands and functions are defined by the programmer, the language will look after program flow automatically.

Colin Watts, the man who invented XL, says XL is the language description, the name of the family, while X-TRACT is an implementation of the XL language in interpretive form. "It mixes program paradigms. That is, it has the flow control of data directed programs, data directed, semantic network-based elements and has frames."

An expert system has three clearly defined parts. The rule System is the section that contains the rules and conditions that dictate the flow of the program. They can be likened to very complex IF...THEN constructions.



Logging onto X-TRACT brings up this screen

The ED-Shell system shell has a simple rule editor

The Inference Engine is the next part. This looks at the results of the firing of rules and 'expertly assesses the probabilities involved in reaching a solution, rejecting unlikely events and refining the options available.

Finally, there is the user interface through which the user inputs data and information, and receives solutions.

Behind all this is the knowledge base, on which the expert system draws. This knowledge base summarises the knowledge of experts which is programmed into the computer and provides the 'expertness' of the system.

For a moment, let's look at the history of expert systems. The very earliest expert systems were huge, complex programs written with a specific application in mind. They were written in Lisp, in the late 1970s. Famous expert systems of the time are Dendral and Mycin, both from Stanford University. Dendral identified chemical molecular structures; Mycin diagnosed human bacterial infections and prescribed treatments. They had all the components of the expert system intertwined and entangled. To modify anything, thorough knowledge of the program's construction was required.

In 1984, the developers of Mycin made a breakthrough. They stripped the system of its knowledge and came up with a Lisp-based core product they call Emycin. It was an expert system shell, and meant that the inference engine, rules and user interface could be built onto other knowledge bases, and thus different expert systems could be developed. Puff and Sacon were two systems developed using Emycin. Eventually a natural language interface to Emycin, called Rosie, was written too.

At the same time as this was happening, another language arrived on the scene: Prolog. Prolog was based on logic programming, with rules of logic forming the basis of the language. It spawned a number of expert systems, containing, as it did, what was in effect its own inference engine.

Another source of expert systems is the Prospector expert system, written in 1976 at SRI International. It used production rules and probability analysis, or plausible reasoning, to arrive at its conclusions, and was an expert in the field of locating mineral deposits. Prospector laid the groundwork for such expert systems as AL/X, MicroExpert, Savoir and KES.

Besides Lisp and Prolog based tools, expert systems are also found written in Fortran, Pascal, C, Assembler, Forth and even Basic. XL is written in Unix, as the developers believed that the portability of Unix would be of great benefit. For this reason, XL is a significant product on the international scene. It is not simply another usage of Lisp or Prolog, to compete with the dozens of expert system shells already in existence.

There are various levels of expert system product. Strictly speaking, an expert system is a complete system of knowledge-base, rule-base, inference engine and user interface.

An expert language is the language used by developers to construct an expert system. Prolog is a language, as is XL, with its various commands.

An expert system shell is an application that shields the workings of the inference engine and knowledge base from the user, enabling a friendlier interface and the development or modification of the expert system. It translates user commands into a form the expert system understands, and calls the relevant section of the program from memory.

An interpreter is a part of some expert systems that transforms the source program into executable code, and executes it. It does not produce an independent object code program and needs to be present on the computer running the application.

A compiler does produce object code, and this object code can then be run on other machines. In the XL scheme of things, a forthcoming module called XL-ERATE will be the compiler.

The totality of a language, a shell and an interpreter is called an expert system

A	B	A and B	A or B	not A
true	true	true	true	false
true	false	false	true	false
true	unknown	unknown	true	false
false	true	false	true	true
false	false	false	false	true
false	unknown	unknown	unknown	true
unknown	true	unknown	true	unknown
unknown	false	false	unknown	unknown
unknown	unknown	unknown	unknown	unknown

The interaction of true, false and unknown logical operator.

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MODEMS BY DATACRAFT

Help screens are available at the push of a key

Generating rules in ED-Shell is simplicity itself

environment, and that's what X-TRACT is. ED-SHELL and COM-SHELL are the two expert system shells developed with X-TRACT, the former for learning about expert systems, with help screens, windows and able to support only a few rules. The latter is for developing more statistical expert systems.

X-TRACT components

X-TRACT comes in two parts: the X-TRACT Engine (a binary program); and the initial X-TRACT knowledge base file. The engine is what drives the expert system. The knowledge base comprises X-TRACT language elements, plus a range of 10 standard macros and 51 built-in functions, all of which can be re-defined by the programmer, who can therefore establish a unique form of logic or arithmetic.

The knowledge base also contains procedures and network structures. Procedures encompassing forms, commands and functions, operate on the data to generate new data or modify existing data. If unknown data is encountered or generated, it is added to the data base, automatically.

The control part of the expert system determines what rules to apply to what data, and when. It operates automatically and is the part of XL that has taken so long to develop. It saves the user from having to structure data or rules, and gives great flexibility in the production of expert systems.

XL comes as either a tape, or as four floppy disks. To install XL, there is an installation procedure, as for any other supermini application. Then log in, type 'make kb' to give you a blank template, then type 'xl' and away you go.

The display LINE 1> appears. That puts you into the Unix screen editor vi, with all default events and prompts. To start with an existing knowledge base or source file, type 'XL' followed by the name or names of the source files, separated by commas.

The structure of X-TRACT is diagrammatically illustrated in Figure 1. At the surface of the user interface are the rules and conditions applicable to the knowledge base and programmed by the expert system developer. When a question is asked, rules are used as dictated by the flow of the program. A temporary knowledge store, or blackboard, stores temporary rules and commands, and links the interface to the X-TRACT application program itself. This consists of the inference engine, acting on the knowledge base.

Each knowledge base consists of three files – a data file, an index file and an extended binary tree file. Dumping the files won't give anything intelligible.

X-TRACT occupies 200k, and grows to from 500k to 1 Mb depending on the expert system. It is written in C, and is Unix bound at present. It maintains itself internally, as far as memory management goes. It uses the Unix cursors I/O package, a screen optimisation package incorporated to speed up development, and a few system calls for management. These are the only Unix dependencies, and ISR is in the process of removing these, so the system can be ported down to MS-DOS machines.

Theoretically, XL can accommodate 2^{32} entries, far more than you'd ever need. Available memory is more of a limitation. In its current form, there can be 50 rules or so. That's not a lot, and ISR is looking for big improvements when the compiler is made available. The typical compiled expert system on a PC with 1 Mb of memory might have 200 rules and say 60k of code, but wouldn't have the overheads associated with the interpretive version, and so would have less interactive capability. It will also have modules to allow data from external databases to be read in.

X-TRACT is a high level language,

	Integer	Floating Pt	Char Str	Date	Time	Dollar
Integer	integer	floating pt	char str	date	time	dollar
Floating Pt	floating pt	floating pt	char str	date	time	dollar
Char Str	char str	char str	char str	char str	char str	char str
Date	date	date	char str	date	integer	integer
Time	time	time	char str	integer	time	integer
Dollar	dollar	dollar	char str	interger	integer	dollar

The result produced by different variable types in a mathematical operation.

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using commands that are very close to English. There are 37 reserved words, plus mathematical operators. X-TRACT's reserved keywords must be entered in lower case. All reserved words are backed up by help in the system. Type 'help "expand"' to get an explanation of the word 'expand'.

The display is text only, but the number of lines and their width can be changed with the commands length, width and size. There are a number of macros, to get file directories, print files, edit files and send files to the Unix mailx system.

Modes of operation

X-TRACT can operate in several modes. One is an expert mode. With the expert mode switched off, expressions or variables have either true or false values and X-TRACT behaves as a standard procedural language.

In the expert mode, a logical variable or expression can have one of three states – it can be true, false or unknown. Where X-TRACT differs from conventional languages is that true and false states can be quantified, from zero (definitely false) to one (definitely true), to describe the degree of certainty attached to true or false statements.

The unknown state is not found in conventional languages either, and is the basis of the inference engine. When the inference engine encounters an unknown variable or expression, it expands the problem within the knowledge base, and uses the rules it has to try to resolve the unknown expression.

There are two useful subsystems with X-TRACT. The first is a trace subsystem. With this switched on, all keystrokes are written to a file. The file can be replayed interactively to allow error tracing and a session to be re-created.

The calculator subsystem turns X-TRACT into an interactive calculator. It is the sort of facility programmers might use, but of little value to other users.

X-TRACT programs are written in sentences, and they don't have to be in any particular order. Sentences can be statements, expressions or procedures. Working with them gives a great deal more flexibility than working in conventional languages.

Sentences or programs should be tested interactively before they are put into memory. That way the programmer knows each particular routine works as it is meant to.

The procedure sentences are again of three types – commands, functions and forms. Using these procedures, blocks of X-TRACT sentences can be grouped together under a single name.

To identify blocks of statements, a description can be put on a separate line and enclosed in curly brackets, or prefaced by a semi-colon. This gives the same effect as a REM statement in Basic. There is a clear command too, as in Basic, to clear a screen.

Statements are quite simple. They declare a condition, or move data between X-TRACT and the computer environment. Statements do not return a value to the point of call.

Expressions do return a value. Words that can be used in an expression are expand, forget, frame, justify, of, remember, variable and the mathematical operators. These words are not the sort you find in ordinary languages.

Nor is something called auto-typing a feature you find in many other languages. When an expression is processed, X-TRACT automatically puts the correct data type to the returned value, whether it be a constant or a variable value. X-TRACT supports double and single precision integer and floating point numerical representation, fixed and variable length character strings, data, time and dollar data types. Data types can be re-assigned by the programmer too.

Variable names can be up to 256 characters long, using upper or lower case letters, numerics and the underscore mark. Variables play an important role in the working of X-TRACT: for instance, a local variable can be specified. Another useful feature of X-TRACT is that the programmer can set allowed values for a variable, with the 'allow' command, followed by the premissible values. The command 'disallow' is the opposite of this.

Variables can be used as powerful links between data; can belong to other variables; or have variables attached to them; and can have attached functions. With the command 'attach' functions can be placed to act on data as it comes into a variable, is passed on from a variable, and in both cases, determined by whether the variable is on the left or right hand side of a variable assignment statement. 'Detach' is used to remove a function from a variable. Variables can therefore act as functions, commands or rules.

X-TRACT supports a wide range of mathematical operators, such as +, –, *, /, plus the functions exponentiation, sin, cos, atan, log 10, square root and absolute, with brackets to indicate priority operations. Strings can be added together (concatenated) or subtracted using the + and – operators. If two incompatible data types undergo an arithmetic operation, X-TRACT auto types the result, according to the chart.

Six relational operations are supported: equality and inequality, less than and greater than, less than or equal to and greater than or equal to. When comparing character strings, lower case letters are less than upper case letters, and shorter strings are less than long strings.

The Boolean operations of AND, OR, NOT can be performed on true, false and the special unknown value. NOT Unknown produces Unknown. A False or True AND Unknown results in Unknown, Unknown OR False results in Unknown, but True OR Unknown produces True.

To support procedural applications, X-TRACT has 'if ... else' and 'while' com-

Reserved keywords

Procedures		
command	form	function
Expressions		
expand	justify	variable
forget	remember	
frame	operators (+, /, –, *, of)	
Non-I/O Statements		
allow	enable	report
argument	flush	return
attach	footer	rule
begin/end	header	screen
body	if	set
clear	local	while
disable	relation	window
disallow		
I/O Statements		
append	message	read
get	put	

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mands. The screen entries for these routines are

```
if (condition) begin
  statement1
end else begin
  statement2

while (condition)
  statement1
end
statement2
```

Screen editor

The screen editor is used to enter commands and rules to the knowledge base. To define a command, type in 'command' and the name of the new command. On a new line, type 'begin'. Then enter the command procedure, and when completed, type 'end' on a new line. So, if we wanted a command 'display-welcome', we would do this:

```
command display_welcome
begin
message "\n Welcome to
my expert system\n"
end
```

Typing 'display-welcome' would then give the output 'Welcome to my expert system', 'Message' is the X-TRACT command that outputs a text string to the screen. The /n in the message character string indicates a new line. That's the simplest of commands. Let's say you wanted to customise it to have the name of the user added to the welcome. You are adding an argument to the command, and the procedure is this.

```
command display_name
argument item
begin
message "\n Welcome,
" + item +", to my expert
system\n"
end
```

To the command line 'display-name Kester', X-TRACT would return 'Welcome, Kester, to my expert system'. It takes the value of whatever follows 'display-name' as the item, or argument, and substitutes that in the output. Whenever a new variable is encountered for the first time, it is auto typed, in this case as a string. However, the argument takes the current value of that variable, so if 'Kester' were to be revalued to say 'Kester Cranswick', (by entering Kester= "Kester-Cranswick"), typing, 'display-name Kester' would then output a message with Kester Cranswick replacing Kester.

Any defined command can be used in subsequent command definitions. So, 'display-welcome', once defined, could form a line of any new command.

If a command line extends over more than 80 characters, an ampersand (&) tells X-TRACT that the command continues on the next line. There is another way to solve this problem too. A long message could be split into a number of shorter strings, and part of a command could add the strings together. One of the strings might be an argument too. Here's an example:

```
command display_long_text
argument item
begin
string 1 = "\n This long
message, although it contains
the word "
string 2 = item
string 3 = ", \n really
makes very little sense to
anyone.\n"
message string 1 + string2
+ string 3
end
```

Now, entering 'display-long-text banana' results in a display of: 'This long message, although it contains the word 'banana', really makes very little sense to anyone.'

Let's take things a little further, and construct a routine that prompts the user for an argument if none is given. It uses an if...else loop.

```
command display
_prompt_text
argument item
begin
if (number_of
_arguments eq 1)
begin
string 1 = "\n This long
message, although it contains
the word "
string 2 = item
string 3 = ", \n really makes
very little sense to anyone.\n"
message string 1 + string2
+ string 3
end else begin
read name, "What word do
you want to have used"
display_prompt_text name
    end
end
```

'Number-of-arguments' is a predefined X-TRACT function that returns the number of arguments. 'Read' is a command that reads input data and assigns it to the named variable, in this case 'name'. It automatically appends a question mark to the text following it, and therefore is similar to Basic's INPUT command. So, the command 'display-prompt-text' prompts the user to input a word if none is entered after 'display-prompt-text' with 'What word do you want to have used?', and then displays the two line message.

Functions

Functions differ from commands in that they return a value. It is the same difference as that between an expression and a statement. In fact, a command is simply a compound statement, embodying functions and other commands.

X-TRACT has 51 in-built functions, though a number are for the forthcoming compiler. They include functions to manipulate the stacks; display the current object, rule and variable type; carry out certain interfaces with the Unix operating system; change the system prompt; change the knowledge base; save and load files, procedures and frames; generate a random number; and select the minimum and maximum value from a pair.

Defining a new function is very similar to defining a command. The only extra thing that needs to be added is a 'return' command to get the data value back to the point of the program that called the function. Here is a defined function that adds a user-entered value to the local variable 'a':

```
function add_value
argument value
local a
begin
a = 1
return value + a
end
```

Note that the argument to this function is a value. So typing 'add-value 1' makes 'a' equal to 2. You can also enter a pre-defined variable, after the function.

```
b = 3
add_value b
```

The variable 'a' is 4 at the end of this.

Auto-typing comes to the users aid if a value that is incompatible with the local variable is added. Suppose the 'a' were a string variable, and you typed a number after the function 'add-value'. X-TRACT would realize a string and a number can't be added together, and has an internal table to which it refers to find out what to do. In this case, it treats the numeric value as a string, and concatenates the two strings. Facilities such as this distinguish X-TRACT from other languages.

Functions can also be written recursively, taking the returned value and operating on that indefinitely unless a conditional statement is included. And, to further advance things, we'll write a command that adds a user-defined value to a variable, until it reaches a higher, user-defined limit. We are using two arguments now.

```
function add_limited
argument value, limit
local a
begin
  a = 1 + value
  if (value gt limit)&
  begin return no
  end else begin
  message "\n Present sum
  = " + a + "\n"
  return add_limited a, limit
      end
end
```

The conditional if statement tests to see if the current value of 'a' is greater than the limit entered. If it is, the 'begin return no' line exits from the function. If not, the following loop is executed once, and the call is made back to the beginning of the function.

Frames

So far X-TRACT seems like any other programming language, with a few special features. However, when you examine the relationships it can support, you enter another world — the world of knowledge. It is all to do with frames.

The interaction with an X-TRACT expert system is by forms, defined by the programmer. These are screen templates with data or prompts displayed. They have three parts — a header, a footer and a body. Areas for input or output of data can be aligned left or right or centred.

Forms can also have windows created in them. A windows allows another form to be displayed. A window might display a help message, or instructions. Forms are also the means of outputting reports. They can contain statements dictating the page size and have headers and footers or windows.

Forms are created by the user with the editor. They contain variable strings and constant strings, acting as prompts or variable identifiers. Using forms, data can be input to the database. By the use of the command 'append', new variables to a form or new forms can be added to a report.

A form is created within a 'begin/end' block. Type 'form' followed by the name of the form, 'begin' on a new line, and then the text to appear on the form, enclosed in quote marks. Use tabbing and spacing to get the text where you want it to appear. X-TRACT handles only straight text, so prettying up forms with bold and italic letters is not possible. It is a cosmetic feature that could be useful, but may come in a later incarnation of X-TRACT.

If the form is to be used in input data, blank data input fields are defined as being from the first letter of the variable name to a '<' mark. So, a name and address file, with screen prompts, would look like this on the edit screen.

```
form address_form
begin
        "ADDRESS FORM"
"-------------------------"
"Surname    "surname      <
"First name"firstname     <
"Address 1  "address1     <
"Address2   "address2     <
"State      "state        <
"Postcode   "postcode<
"-------------------------"
end
```

To display a form, type 'put' form name 'screen'. The above form would be displayed with its title, the prompts for information, and, unless the variables already have a value, the variable names. If we have defined a header and a footer, they would appear too.

There are two ways to get blank displays against the prompts. The first is to define all the variables to null strings before calling the 'put' command. Alternatively, by redefining the UNDEFINED event, which is fired whenever an undefined variable is met, the form could be output so that the initial values of the variables would be zero, therefore causing blanks to be displayed against the form prompts.

However, this form won't accept data input. To actually input data, other commands are needed. Firstly, 'set screen body form-name' tells X-TRACT that the new form is to be the body of the screen. Then, a new form is created that functions only to accept data input. We might call this form 'entry-form', as it has none of the cosmetic features of the first form – just a list of variable names in a 'begin/end' block.

To enter data, type 'get entry-form from screen'. This displays the original form with dashes to indicate the length of the active field for each variable. The user enters the relevant data, and thus the variables are assigned.

To turn a form into a frame, the double equals sign is used. Now, suppose we want to automatically create a frame that has the title of the surname of any person whose name and address is entered via

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the address form. No problem. If we put a line @ surname == frame entry-form', then X-TRACT looks at the value of the variable 'surname', makes that value the title of a frame and the 'frame' command turns the form data into a frame. With 'list-frame' we can see a display of the data, and with 'save-object' we save the frame to the knowledge base. This procedure could be automated, and here's how:

```
command make_frame

argument surname

begin
surname == frame entry
_form
shift_object surname
message "Making frame for
" + current_object + "\n"
save_object surname

end
```

In the command to fill in a form, have the line 'make-frame (@surname)'. This makes the surname in the entry frame the argument. The frame then takes the surname as a title, 'shift-object' makes the new frame the current frame, so its title can be displayed in the message, and the frame is saved.

This might be thought of as a record in a conventional database. However, a frame can contain other frame names. Each frame has a name, and is simply a list of statements or values, each in a particular slot. A slot can contain a number of values, be empty, or contain the name of another frame. By having other frame names in a slot, different frames are interconnected. For instance, a frame called Software Manufacturer might look like this:

```
Software Manufacturer
Company: Intelligent Systems
Research
Products: PRODUCT RANGE
(referring to another frame)
Location: Camberwell
```

A feature of the X-TRACT frame facility is an 'if-needed' procedure. It defines how a slot value can be calculated from existing data and is called whenever the value of that slot is needed for further calculations. Let's say you know the volume and density of granite, and the frame GRANITE has a slot called Weight. Granite might be a slot on a frame called ROCK, and ROCK contains a function that calculates the weight from volume and density. To find the Weight value, X-TRACT goes back to the ROCK frame, uses the Weight function and puts the result of the calculation in the Weight slot of the GRANITE frame.

Knowledge types

Knowledge can be classified into two classes. Descriptive knowledge is knowledge that describes the attributes of objects, facts and concepts. It also describes the relationships between objects, facts and concepts. 'Apples are red and grow on trees' is an example of descriptive knowledge.

Sometimes an object does not quite fit a certain descriptive category. XL allows for this, in the implemenation of fuzzy logic. Instead of saying that something is or isn't whatever, a value between zero and one can be given to the link between the object and its category. A zero value indicates that the object definitely does not belong in the category. A value of one means that it definitely belongs in the category. Any in-between value can be set too.

Procedural knowledge is more abstract. It details the rules and commands that are applied to a knowledge base. For instance, a DOS manual is procedural knowledge, as is a recipe for apple pie. It is by use of procedural knowledge that descriptive knowledge is manipulated.

Knowledge in expert systems is described by nets and trees. A net is, in its simplest form, two points (objects or facts) connected by a link. The points are known as nodes. If one of the nodes is derived form the other, using the defined link, then the net is described as a directed net.

A tree is a diagram of a complex net, and as you might expect, has a branching structure. A root node is linked to two or more inferior nodes, which are in turn linked to more inferior nodes, and so on. The lowest nodes are known as end nodes. Paths between nodes can be drawn along the links, and are known as branches. If two nodes can be reached by using two or more paths, then a loop is said to exist.

Nets are called labelled or semantic, depending on the form of the nodes. If the nodes are simply symbols, with no inherent meaning, the net is a labelled net. If the nodes have meaningful assignations, the net is a semantic net.

In expert systems, semantic nets are common. The nodes are objects or facts, and the links are the relationships between them. For instance two nodes might be 'apple' and 'red', and the link might be 'colour'.

X-TRACT constructs semantic nets with the command 'remember'. The syntax is 'remember object, relationship, target'.

A typical remember statement might be 'remember Roger, breed, Pointer', meaning exactly what it says. In X-TRACT, when a remember statement is encountered, a new frame is set up, with the name of the object, in this case, Roger. The relationship becomes a slot and the target, the slot value. Note that an underline indicates meaningful space, and enables relationships of several words to be used.

If a new remember satement is entered, with the same object, the new relationship and target is added to the object's frame. So, if we also entered 'remember Roger, owner, Kester', we would have this frame:

```
Roger

        breed       : Pointer

        owner       : Kester
```

To save a frame, X-TRACT has a command 'save-object'. To save the above frame in the knowledge base, type 'save-object Roger'. To recall a frame, the command 'list-frame' is used. Within this pre-defined function is a routine that puts the word 'is' between slot names and slot value. So, 'list-frame Roger' displays:

```
breed is Pointer

owner is Kester
```

The 'is' could easily be redefined to be any other value, a dash, or a colon, for instance, by re-refining the 'list-frame' function. Also, X-TRACT, by default, lists the slots in a frame in alphabetical order. Again, this feature could be redefined in the 'list-frame' function.

If we want to find the value of a particular slot in a frame, we use X-TRACTs 'of' function. Typing 'owner of Roger' causes X-TRACT, in this case, to display Kester. If the frame does not contain a slot or slot value for a query, X-TRACT fires a function called RELEVENT, which returns the word 'unknown'.

X-TRACT can also forget items in a frame, with the command 'forget'. Typing 'forget Roger, owner, Kester' and saving the frame would delete that information from the knowledge base.

To delete a whole frame, we make it equal zero, or empty, by typing the command 'Roger == o'. The double equals sign applies only to frame, rather than

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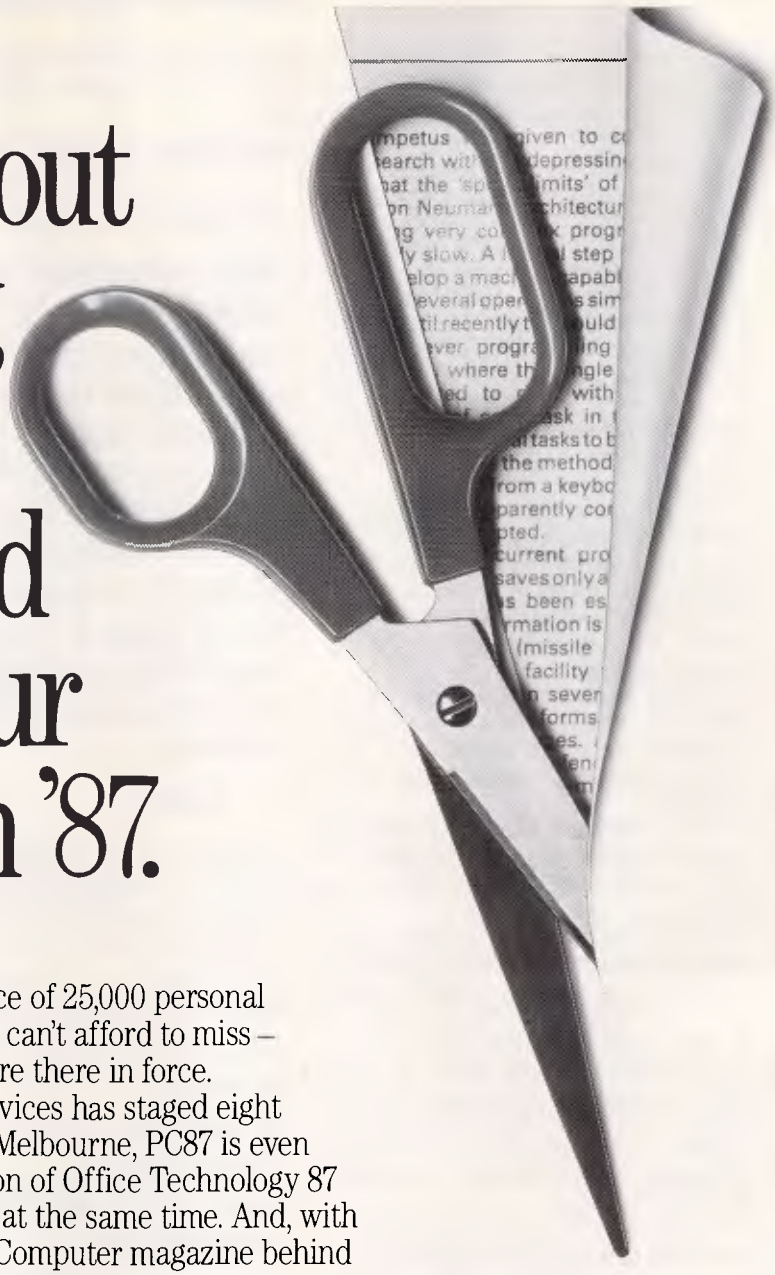

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variable operations, and assigns the number 0 to the frame Roger. Numbers cannot have frames attached to them, so the frame Roger is deleted.

We can also use frame assignment to copy frames, by typing in a command of the form 'new-frame == frame'.

A major key to expert systems is inference – the deduction of conclusions by logical reasoning. Syllogism is one form of inference. If two statements have a common factor, a third statement can be deduced. For instance, if we know that "All *APC* readers are intelligent," and "Bob Hawke is an *APC* reader," then we can infer that "Bob Hawke is intelligent."

Syllogism is a rule, and a rule that can be used by an expert system. And like all rules, it follows the general form of IF (antecedent) THEN (consequent). The antecedent may be a complex set of conditions, but if it is true, the consequent can be inferred.

The consequent may deduce further information about an item of knowledge. To extend the above example, "IF Bob Hawke is an *APC* reader THEN he is intelligent."

The consequent might also take the form of a command or an instruction: "IF Bob Hawke is an *APC* reader THEN invite him to your next party."

We can use the expertise of X-TRACT to add slots and slot values to a frame if nominated slots have certain values, based on syllogism. To do this, an 'if...then' construction is used.

For instance, if we know that any object belonging to Kester lives in South Melbourne, we can use the command: 'if (owner current-object Kester) then remember current-object, residence, South-Melbourne'.

The term 'current-object' is a variable that refers to the last frame referenced, in this case, Roger. 'Owner' is the slot being examined. If the slot value equals Kester, then X-TRACT creates the new slot and slot-value in the frame indicated by 'remember'. So, the updated frame looks like this:

```
Roger

breed      : Pointer
owner      : Kester
residence  : South Melbourne
```

To do a global firing of commands, on a number of frames, the command 'relation' followed by a lost name is used. This defines a slot as a variable, and allows X-TRACT to search all frames for that slot, and then evaluate the rule. If we had a number of frames with a slot' belong-to', this is how to apply the rule to them all:

```
relation owner
if (owner eq Kester)
then remember current_
object, residence,
South_Melbourne
expand all rule owner,
current_object
```

Note the **expand** command in the last line. This is a critical command in X-TRACT. It operates on either rules or frames, expanding them according to the if/then constructions present.

Rules

Rules, to be used in any command, are defined by the programmer using the editor in the way that frames, functions and commands are defined. The generic form is:

```
rule rule_name, [certainty
_factor], [justification_link_
to_rule 1]
if (left_hand_side
_expression)
then (right_hand_side
_expression)
```

In XL, all rules are stored in two master control frames associated, called 1hs-frame and rhs-frame. Each of the two frames contains slot names corresponding to the identifiers in the rules (everything in the parentheses), and slot values of the rule name. Rule frames can be displayed with the 'list-frame' command.

For the above example, we would define rule 1 as follows:

```
rule rule 1
if (owner current_object
eq Kester)
then (remember current
_object, residence,
South_Melbourne)
```

The two master control frames created are:

```
lhs_frame
owner is rule 1
current_object is rule 1
Kester is rule 1
```

```
rhs_frame
current_object is rule 1
residence is rule 1
South_Melbourne is rule 1
```

Rules are not executed until the command 'expand' is used. Expand can operate on frames, matching relations, or on rules, matching character strings. In the frame context, it is a good deal less sophisticated, and is basically an if/then command. The syntax for 'expand' is 'expand all 1hs rule control-frame 'pattern', object-frame. In this case, we would enter 'expand all 1hs-frame 'owner', Roger'. X-TRACT references the 1hs-frame, searches the current-frame (Roger) for the slot matching 'owner', checks that the rule is satisfied and executes the rule.

'Expand' operates only on the frame at the top of the stack, the current frame. 'All' makes 'expand' operate on all rules in the master control frame. If it is omitted, only the first match to a pattern will be expanded. A programmmer can also specify that 'expand' references a rule frame other than the master control frame. A function can also be attached to the command, acting on the contents of any matched frame.

When matching patterns, the usual wildcards, * and ?, can be used. * signifies a string of any length, ? a single character. By using the * wildcard match, if one rule fires, it can cause certain data to change, and this may cause subsequent rules to fire, as there is no restriction on what pattern matches X-TRACT will look for.' Here's a two rule example.

```
rule rule2,,just_rule2
if ((colour of reaction)
eq green)
then ((remember reaction,
result, successful)&

and (remember reaction,
state, complete))
```

WHO IS HAL?

```
rule rule3,,just_rule3
if ((state of reaction)
eq complete)
then ((remember
equipment, power, off)
```

If a frame 'reaction' has a slot 'colour' and a slot value of 'green', then 'expand all 1hs rule 1hs-frame, "*", reaction' checks all the slots in the frame. In the slot 'colour' it finds a value 'green', satisfying the rule. So, it adds the slot of 'state is complete' to the frame 'reaction'. The slot search then continues, because of the wildcard, and comes to the 'state' slot, which has a value of 'complete', thereby triggering rule three. Note that if the 'colour' had been 'blue', neither rule would have been triggered.

So, a consequent may form an antecedent for further consequents and a particular consequent may have more than one antecedent. In this manner, inference nets, with nodes and paths, are built up, and we have the start of an expert system. The satisfaction of antecedents, leading to a series of consequents, is a process called forward chaining. Many expert systems use forward chaining. Based on a known or given set of facts, the expert system is able to work out conclusions by working down the inference net.

In X-TRACT, forward chaining is achieved by expanding the 1hs-frame. The reverse, backward chaining, or going from consequent to antecedent, is done by simply expanding the rhs-frame.

The links between nodes in an inference net provide a means for an expert system to give justification for a conclusion. When a solution is reached, the user types in 'justify relation-name' and the program lists the rules it used in order to reach its conclusion. Each step can then be checked. The event JUSTEVENT could be redefined to output more than the rule name. For instance, it could be defined to display a rule in its entirety.

X-TRACT can also deduce the certainty of a given conclusion, expressed in a numerical form. The programmer can assign a number, describing the certainty of a given link, over a range of zero (impossible link) to one (certain link). X-TRACT calculates the total probability of a conclusion from these values.

Event definition

X-TRACT has five different types of event: interactive events, knowledge events, mathematical events, logical events and conditional events.

The two interactive events are PROMPTEVENT and UNDEFINED. The former defines the onscreen prompt which appears. The latter is used by the autotyping mechanism which gives an undefined variable a variable type.

The two knowledge events are RELEVANT and JUSTEVENT. RELEVANT is called on when a relation is encountered that is not satisfied by the contents of a frame, ie if the relationship is not present in a frame. JUSTEVENT is called whenever X-TRACT has to justify a conclusion by backtracking through the inference net.

Mathematical events are ADDEVENT, SUBEVENT, MULTEVENT, DIVEVENT, EXPEVENT and NEGEVET, giving addition, subtraction, multiplication, division, exponentiation and negation.

ANDEVENT, OREVENT and NOTEVENT are the three logical events. The condition event, CONDEVENT, is called whenever a conditional operator (eg, ne, lt, gt, le and ge) is encountered. There are 118 error codes in X-TRACT, plus 15 undefined error codes that could be defined by a programmer.

Great flexibility is given by the way X-TRACT programmers can change the manner in which the events which occur in X-TRACT operate. So, the manner in which X-TRACT performs logic or mathematical operations, what X-TRACT does when it encounters a new variable (or an unsatisfied relation) can be changed to suit different applications. This is because an event is treated just as any function.

The commands to change the operation of an event are as follows:

```
function event_name
argument func, [var 1],
[var2], [result], [status]
begin

  statement(s)

  return return_variable

end
```

'Func' is a character string that describes the event. 'Var 1' and 'Var2' are the active variables. 'Result' is data from the action causing the event, and 'status' is either false, true or unknown.

So, to change the way mathematics is performed, alter the functions in the mathematical events. Or, you can have X-TRACT automatically generate a new frame if a new part number is entered as a variable, by redefining the UNDEFINED event:

```
function UNDEFINED
argument undefined
_variable
begin

if (symbol_name of undefined
_variable eq "part-*")

begin

undefined_variable ==
part_frame
undefined_variable = symbol
_name of undefined_variable
return undefined_variable
  end

  return ""

end
```

Conclusion

The aim of an expert system is to use existing knowledge to derive new knowledge. An expert system is only as good as the knowledge on which it can draw.

The knowledge needs to be both extensive and exhaustive. Any gaps in the knowledge base may lead to faulty solutions to problems. There is no means to test whether an expert system is expert in all situations, bar exposing it to all situations, and contrasting its results with those of a recognized, human expert.

Learning knowledge engineering is quite different from learning to program in X-TRACT. It consists in learning how to extract knowledge from an expert, who may not be articulate in describing his or her knowledge, and how to work out rules based on that knowledge.

Any user with some programming experience will be able to start using X-TRACT immediately. But shell users won't need to know how it works, as forms will dictate screen format, and help files will be on hand. To make major changes, Watts recommends that developers have several years knowledge engineering experience.

The advantage of X-TRACT is that it has few of the constraints of other expert systems. It is entirely up to the expertise of the programmer to decide what shape a shell should take. He is not constrained by the ability to do only forward or backward chaining. He can change the mathematical or logical operators of an expert system, and make up any rules necessary. It is a very flexible, very open

meet **HAL**

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language for building expert systems with a wide range of tools, and suitable for a wide range of machines. It lacks graphics, costs a great deal of money, but for serious devleopment work, it is excellent.

X-TRACT has all that it takes to build sophisticated expert systems, for almost any market. That may be a problem though. In not defining its market, it may not appeal to any. And, in the early days, there are going to be very, very few programmers with any experience in using the new language. That will hold back developments.

Whether XL will succeed depends on how quickly it gets off the ground. The Victorian government is to be congratulated for putting some money behind a project that has yet to prove itself. The truth is that ISR may come a cropper with XL, not because it is lacking in anything, but because it is a competitive world out there. It has got a dream start, thanks to the politicians, and if the momentum can be maintained, in a few years time, maybe even you will be using an Australian designed expert system, written in XL. And, if it does take off in a big way, those ISR shares are gong to be worth a lot more than they are today.

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SCREENTEST

Microsoft Works

Microsoft Works is everything Lotus Jazz should have been — but wasn't. This inexpensive, integrated product for the Apple Macintosh comprises four basic modules and offers power, functionality and ease of use for novices and experienced users alike. Geof Wheelwright an Yvette Stachowiak put it through its paces.

Why integrated software?

Why this great obsession with integrated software? The reasons are relatively simple and have as much to do with the way software is marketed as the way it is used.

Integrated software was first conceived as a way of providing everything you could possibly want in a general business application and tying it all together in one neat bundle — no switching in and out of different packages and only one price to pay for buying it.

Convenience, the ability to transfer data between applications and the need to only learn one common set of commands were the biggest attractions of integrated software. Funnily enough, however, Lotus Development also thought that this type of software would largely appeal to its 'power users' — not beginners.

Thus both Lotus Symphony for the IBM PC and Lotus Jazz for the Macintosh were priced — and pitched — at the upper end of the business market. The company figured that a figure of about $900 was quite justifiable since buying each of those applications separately would cost you at least that much.

But the problem with Jazz, Symphony — and even Ashton-Tate's Framework — is that they weren't more than the sum of their parts. In most cases, they were rather less.

Simply put, the word processor and database in Symphony were not up to the standard of the best stand-alone PC word processors, while the spreadsheet and graphics ability of Jazz could not give the same performance as more single-purpose calculation applications such as Microsoft Excel.

In short, integrated software was not for the 'power user'. The very fact that so much code — to do so many things — had to be fitted into the same space inevitably made the integrated application look sparse when compared to its stand-alone predecessors.

Oddly enough, one of the first companies to recognise this was not a software company. It was Apple Computer, which launched its Appleworks product for the Apple II line of computers at the same time as it launched the portable Apple IIc.

Appleworks was a low-cost integrated package designed with the aim of providing maximum power in each of its applications at the lowest possible cost. It became one of the hottest-selling business Applications Apple had ever had for the Apple II in the US.

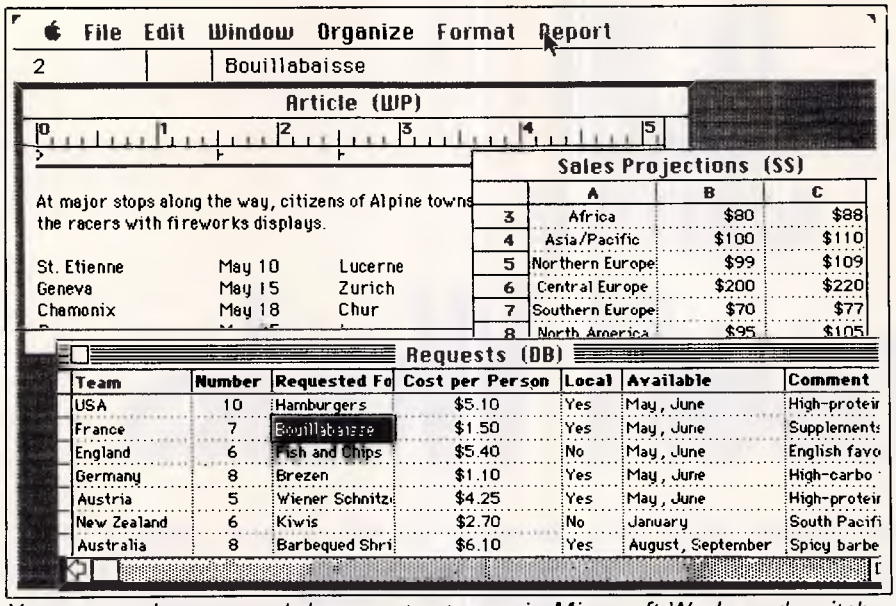
Life hasn't been easy for experienced Apple Macintosh users.

In the early days, you mastered the free MacWrite word processing program which came with the machine, but soon found it so limited that you may well have been forced to splash out and buy Microsoft's Word W/p software. No challenge being too great for you, you then may have moved on to try the Microsoft suite of File, Chart and Multiplan.

But the ultimate answer must have been just around the corner when you heard about Lotus Jazz, the all-in-one software system which combined word processing, database, spreadsheet, graphics and communications functions in one convenient package. While it did come from the same software stable that produced Lotus 1-2-3 and Symphony and Jazz approach to 'integrated' applications did seem to be the way to go, Jazz actually turned out to be so complex that it likely left you yearning for the simpler days of MacWrite.

You might then have worked through the vagaries of Apple's Switcher and looked at a number of the other pseudo-integrated packages which appeared for the machine. The problem with those that rely on the Switcher is that memory problems often prevent you getting enough programs into the Switcher rotation for it to really work effectively — particularly on the 512k machine.

The Switcher (especially on floppy-based machines) can also be very slow — unless you set aside even more memory to allow some of the software (assuming it's not copy-protected and will allow you to do so) on a RAM disk.



You can work on several documents at once in Microsoft Works and switch data easily between the various modules so that spreadsheet, database and graphics data, for example, can be incorporated into a Works word-processing document

The Switcher also doesn't get round the problems of different command structures within the applications that are part of a Switcher rotation. So it's easy to get confused between the command structures on a database (where Option S might used to issue to the Sort command) and a word processor (where Option S is far more likely to be the Save command).

Given the limitations of Apple's Switcher, you're still probably looking for the perfect Macintosh 'all-in-one' application.

Enter Microsfot with its new integrated product for the Apple Macintosh, offering low-cost, a fair degree of functionality and a great deal of ease of use.

Known as Microsoft Works, the package contains word processing, spreadsheet, database and and communications software. And unlike Jazz, it doesn't try to compete in the 'mega-spreadsheet' wars (as Microsoft's own Excel is already supreme in that area) and thus can devote almost equal power to all part so of the program.

But unlike many integrated suites, it is not a software throwback (that is: individual components do not look like throwbacks to earlier versions of stand-alone software). It epitomises the axiom 'the simpler it is, the harder it is to get it right'. And Microsoft Works get it right.

Microsoft not only gets it right for experienced Mac users, but also for novices eager to take advantage of the Mac's easy-to-use facilities. A quick glance through the tutorial lessons which accompany this package will undoubtedly ease any first-time user nerves.

The hardware you need to run this suite consists of a Macintosh Plus, a Macintosh 512K with at least a single 800k floppy drive or a Macintosh 512k with two disk drives. A hard disk would not go amiss here, but the program can run nicely without one — albeit somewhat slower.

Unlike Jazz with its proliferation of disks, the Beta copy of Works that we tested came with just two disks — a program disk to be inserted in an external drive and the start-up disk for the internal drive. On a Mac with 800k drives, that would be reduced to a single disk — with room left over for data files!

Our Beta copy was also not copy-protected (and no, you can't have a copy), but Microsoft advises us that the final production version will be copy-protected.

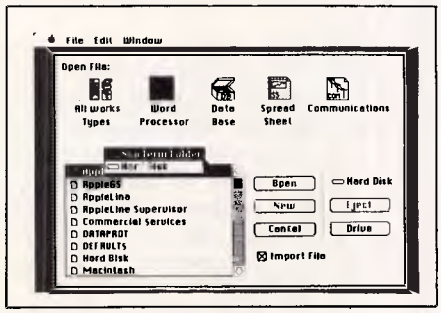
The copy protection issue seems to form part of a schizophrenic policy in major software houses such as Microsoft and Ashton-Tate. Both have decided to remove copy-protection on all the IBM PC applications software, yet maintain it on the Macintosh programs.

Getting started

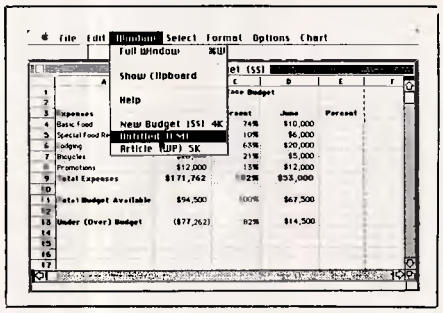
To start using Microsoft Works, you need only 'double-click' on either the 'Works' icon or the 'Resume Works' icon (the former will merely start the program while the latter will actually reload all the documents you were working on when you last used Works). When the program has loaded — with almost all of it in memory, rather than on disk — you are presented with a screen that offers you a view of all your Works files, or a selection of files defined by application.

Using this opening 'menu', you can select any existing document, open a new document or import a data file from another program. The latter task is handled via a discrete 'import file' box, which will then show both the 'importable' as well as the existing document files in the folder directory at the left-hand side of the screen.

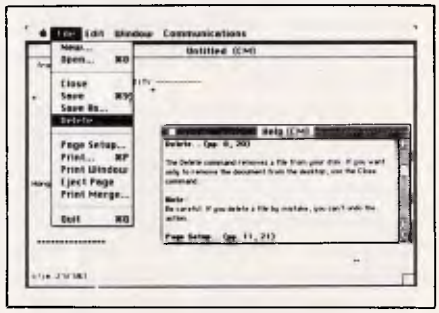
All the usual options for changing your data drive, ejecting a disk and opening a file are available in the opening dialog box — and Microsoft Works fully supports the new Mac Hierarchical Filing System



This is the opening screen of Microsoft Works. Note the onscreen support for the Hierarchical Filing System (HFS) and the ease with which 'importable' files are shown



Even when you're using three documents at once, it's relatively easy to swap between them by accessing this comprehensive pull-down menu



The 'Help' menu in Works is context-sensitive and comes up in a resizable box, so that it only occupies as much of the screen as you want it to

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(HFS), so that full use is made of 'folders' and sub-directories.

Word processing

Works combines the best features of MacWrite and Word to make this word processor simple to use. In addition to the standard commands on the Works' word-processing pull-down menu, there are a few new variations which make life easier for the Mac owner.

The introduction of a 'Delete File' command, for example, is something which should have been added a long time ago. This command brings up a dialog box which allows you to delete a file while you are working on another file, rather than the old-fashioned method of returning to the desktop, throwing a file into the trash-can, then re-entering your program again.

There is also an 'Eject Page' command which advances the paper in your printer by one page. This may not be a spectacular innovation, but at least you don't have to constantly stretch over to your printer to push the 'form feed' button.

Moving over to the 'Edit' pull-down menu, the new 'Draw' command affords a small selection of drawing patterns. They include three thicknesses of lines, circles, hexagons and squares. The program is obviously not capable of giving the spectrum of choices available on MacPaint or MacDraw, but you can create your version of Picasso on MacPaint and import it to Microsoft Works. And unlike almost any other word processor we know of for the Mac, you can type not only beside — but directly through — imported or Draw-command-generated graphics (see screenshot).

Like most of the better word processors you can work on several documents at once in Microsoft Works. These documents can all be shown on the screen at once (if you 're-size' each of the document windows to accommodate them) or you can keep them all full-size and 'flip-through' them using the 'Window' pull-down menu command.

The Window pull-down menu in Works keeps a list of all the documents you have opened, including memory size. To open another window, therefore, you simply click on the title of the document you want from the pull-down menu.

The Window menu also includes access to the 'clipboard' (where you can 'paste' data to be swapped between applications) and access to the 'help' function (which is context-sensitive and shows itself as a small 'read-only' document at the bottom of the screen).

Another interesting item is in the 'Search' pull-down menu. A 'go to page?' command brings you quickly to the top line of the page in question, rather than aimlessly scrolling up and down using the slide bar or cursor keys (included on the Mac-Plus). The only point of contention is that you have to remember the page number you are scanning for.

Formatting functions, however, are relatively consistent with other Mac word-processing programs — but Works does omit Word's myopic and frustrating standard of using 'equals signs' as page breaks and the need to use the accursed repagination command. Standard MacWrite-style page breaks are used instead — with dynamic repagination.

Font and 'style' management commands are also accessible from the word-processing pull-down menus, offering eight typefaces — available in seven sizes and eight styles.

Tabs are incredibly easy to set — you simply click on the ruler at the top of your onscreen page where you would like to position your tab breaks. No longer do you have to drag a tab stop out of an arrow set in the ruler — as in Word — and hope for the best.

The only real drawbacks we could see to the word-processing module are the lack of a word count, a spelling checker and any form of 'outline processing'. Also, the longer your file is, the slower it will perform editing functions such as 'cut', 'copy' and 'paste'.

The size of document files is limited only by the amount of memory you have — as Works is a memory-based program. Like Lotus Symphony on the IBM, the main section of the program is loaded entirely into memory so that it's not slowed down by constant disk-accessing. Unlike Sidekick, however, it is not memory-resident in the sense that it's designed to run alongside other stand-alone programs.

With a 512k Macintosh, you can thus store 60-80 pages in a file, while with the Mac Plus (and its 1Mbyte of RAM) the number is upgraded to 180-240 pages.

If, however, you use a large variety of RAM-hungry fonts and include lots of bit-mapped graphics, the capacity will be reduced. You can always keep

track of exactly how much RAM you've got left through the 'About MS-Works' option.

Database

Works does not offer a sophisticated database, but rather a simple 'flat-filing' system with no real 'relational' ability between database files. It is very much like Microsoft's own File database software for the Mac. It would, in fact, be fair to call it more of an 'electronic filing system' than a true database.

Surprisingly, however, Microsoft has not used many elements of File within the Works database. In fact, to begin with, we couldn't directly import records from Microsoft File (particularly as File allows for the use of graphics data in records and Works doesn't) — as data formats are different in the two programs (they could be imported as ASCII files, but that requires some messing about), so we had to create a number of sample databases from scratch.

Having learned the 'ins and outs' of it, however, the database was actually quite impressive. The simple statistics are that it allows 60 fields in a record, up to 248 characters in any given field, 64 characters in a field name and 200 characters in a computed field formula. And that gives you pretty good scope for a wide variety of databases.

A 512k Mac can store up to 2000 records in a database (100 characters per record), while the Mac Plus can handle up to 6000. This capacity is obviously affected by the number of characters per record.

Once you understand how to set up the Works' database, it is very easy to use. Like most of the popular PC databases, you can view your database record-by-record (forms view) or as a window onto the entire database field-by-field (list view).

We could see the 'forms' view being particularly useful for people conducting surveys or filling in large volumes of information, as it approximates a 'file-card' extremely well. Moving entry fields around on the basic database form is quite simple. You merely select the field with a MacPaint-style 'hand' and then move the field to its new position.

There is a good collection of searching and sorting tools in the Works database — including commands for for finding information in a given field, selecting specified records (using up to six selection rules and a series of

operators) and sorting by numeric value, alphabet or chronology.

Record selection is accomplished via the application of 'rules' (see screenshot). These rules are derived from selecting a field on which the rule is to operate, then the operator and, finally, the record comparison information.

Reporting — often a weak spot on databases — is nicely tied into the record selection processes so that records can not only be printed in an attractive report format easily, but can also be formatted for insertion into a word-processed document without a great deal of trouble.

For those whose primary use of the database will be to provide data to send to the word processor, you'll be relieved to know that mail-merge is supported in Microsoft Works. Merging database records into the word processor to write form letters is accomplished by inserting 'placeholders' (showing the name of the database document from which you are getting the data and the field name you want to go in that spot — ie: Addresses: First Name) at the appropriate place in the document and then using 'Print Merge'.

Spreadsheet

Along with the database, the Microsoft Works spreadsheet is the most complex and powerful of all the applications modules. Since Microsoft produces the best-selling stand-alone spreadsheet (Excel) for the Mac, this should perhaps come as no surprise.

What is a surprise is that Microsoft hasn't knee-capped the power of the Works spreadsheet in order to steer potential Excel users away from it. The Works spreadsheet is a full-blown financial modelling tool that should provide you with most of the calculation and planning power you need for most jobs.

The program's specifications state that the Works spreadsheet can hold up to 238 characters in the entry bar, 200 characters in a formula, 80 columns in a series chart (except the bar chart) and 15 rows in a pie chart. A 512k Mac can cope with 7500 filled cells while the Mac Plus will deal with up to 22,500 filled cells. The length of your formulae and the amount of text in labels will obviously reduce the capacity of the spreadsheet.

The Works spreadsheet has a capacity of 256 columns by 9999 rows and 54 calculation functions — but that, of course, would take up a lot of memory. Like most other Microsoft spreadsheet products, the company says that Works also uses 'sparse memory management' techniques so that placing a number in the last cell in the spreadsheet will take up no more room than placing one at the start.

On all our (Beta versions 4.3 through 7.0) review copies, however, the use of this technique was not in evidence. Placing a single entry in a cell at the far bottom right-hand corner of the spreadsheet caused it to immediately reserve 42k for that spreadsheet. Microsoft says this is a bug that will be fixed in release versions — but we suggest you check for yourself before buying.

Though the spreadsheet's File and Window pull-down menus are identical to other Works' applications, the Edit pull-down menu includes the 'Paste' functions, Absolute Cell Reference, Fill Right, Fill Down and Sort.

The 'Select' pull-down menu concentrates on cell manipulation, while the 'Format' menu deals with common spreadsheet standards, such as per cent, general and decimal choices. Calculation functions, indications of formulae and values, data protection and use of a grid are all part of the 'Options' pull-down menu.

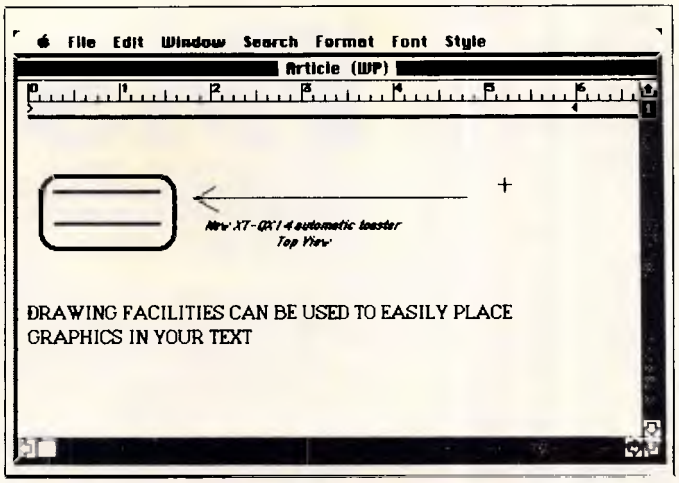
Last, but not least, is a highlight of the spreadsheet application — the 'Chart' pull-down menu. This is one of the easiest and fastest ways possible to plot charts relating to your spreadsheets (see screenshot).

You simply set the parameters for your chart, click the 'Plot it' box and a chart appears. Four different types of charts are on offer — line, bar, stack and combination. Up to eight charts can be saved for each spreadsheet file.

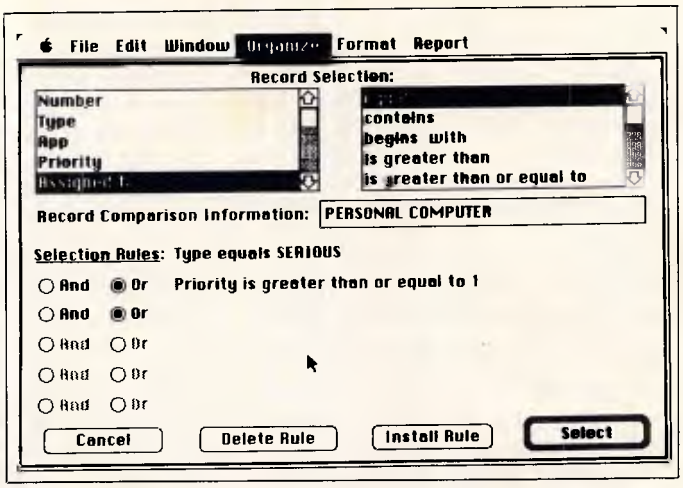
However, before you paste your chart to another application — word processing, for example — make sure you have space cleared for it in your document. If you don't, the chart will be copied onto text already there. You can easily 'undo' the overwriting, but it's best to have a blank space where you can then manipulate your chart until you achieve the desired position.

Communications

Microsoft Works provides a simple-to-use, but quite flexible, communications application within its range of capabilities. Both the lessons for this 'module' and the main Works manual are well-explained and guide the inexperienced com-



Once you've used the Draw command to create graphics, you'll notice that Works allows you to place text and graphics beside one another



Record selection is accomplished by installing 'rules' under which you can select a series of criteria for collecting together specific information

munications user through parity settings, baud rates and hand-shaking.

The dialog box for the communications settings is quite straightforward (though a command to provide a carriage return-line feed at the end of each line would have been nice). Among the other choices in the same pull-down menu for sending or receiving information are 'Echo' 'On/Off', 'Dial' or 'Hang-up', 'Answer Phone' and 'Capturing or Receiving Text or Files'.

Dual access — being able to work on another application while dialling a number through the communication package — is a particularly attractive feature. You will have to adjust the size of your windows, but you can keep an eye on the dialling procedure while you work on something else. Eight telephone numbers can be stored per communications 'document', with a simple 'dial' box to click when you make a call.

Like most US communications modules, however, Works does not offer support for the Viewdata dual/speed graphics standard used by the popular Viatel database.

Desktop publishing

Although Works supports a laser printer and its documents are intended for use in desktop publishing systems, there are a few issues to bear in mind when doing so.

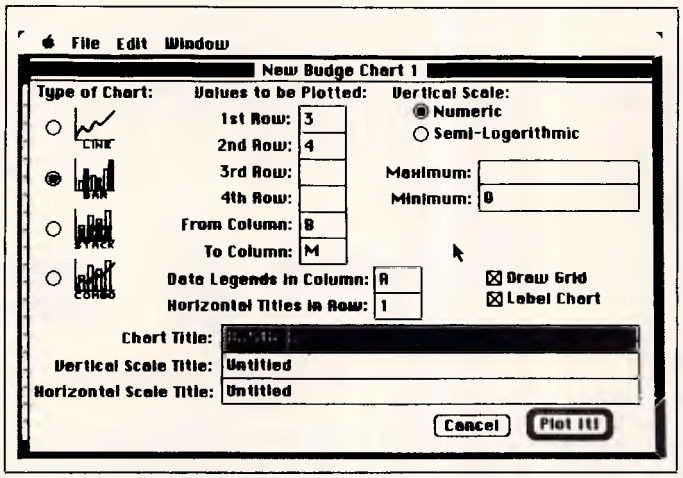
As Works is being released at about the same time as the new version of the popular Aldus Pagemaker desktop publishing software, it is not entirely compatible with the old version of Pagemaker. Pagemaker 1.0 cannot read Works files which use bold face or underlining features — a problem which Microsoft says you should solve by getting the new version of Pagemaker.

General comments

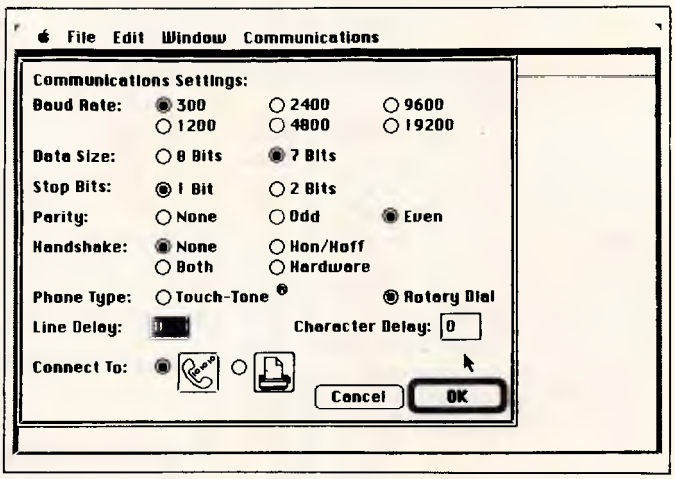
There is an extensive context-sensitive onscreen 'Help' facility which runs through all the applications in Works — allowing you to scroll through a series of Help topics in a resizable box at the bottom of the screen — or use a '?' icon to point at the command on which you need help (see screenshot).

The ability to see both the text you need help about and the answer at the same time gives Works an added advantage over other online help systems that take over the whole screen.

Perhaps one of the largest benefits of Works is its ability to transfer files from other programs, such as Micro-



Spreadsheet 'Chart' box — to chart a spreadsheet, you describe the rows you wish to plot and the columns that they are in



This communications 'setting sheet' is automatically presented every time you open a 'new' communications document within Works

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soft Word, MacWrite and Excel, without difficulty.

You simply open the File dialog box and choose the word-processing icon. You then just choose the folder or drive containing the files to be transferred and click on the Import File box.

The file or files which can be read will be displayed in a scroll-down box. Double-clicking on your file name will open it, though it will be initially untitled.

The database application allows the import of File, Jazz, Appleworks or III E-Z Pieces (the precursor to AppleWorks originally offered on the old Apple III) files. SYLK files from Multiplan or Excel, or text files from spreadsheet programs can also be transferred to Works. AppleWorks files will, of course, need to be transferred using the Apple Access communications software and the communications module in Microsoft Works.

The exporting procedures are just as easy. We had no difficulty in sending a Works file to both MacWrite and Word. You simply click the 'save as' command on the file pull-down menu, click the export box, then save your file. It is now ready to be used by another word processor.

Transferring a Works' spreadsheet's SYLK files to Multiplan or Excel is a more complicated procedure, but is clearly documented in the manual. An extensive chart explains the different functions between these three programs and any adjustments you may have to make.

And, of course, it is quite easy to transfer data between the various modules in Works, so that spreadsheet, database and graphics, for example, can be incorporated into a Works word-processing document.

We have already outlined how you can merge database files to accomplish 'mail-merging' in the word processor, but you can also copy from the database data in List mode, and vice-versa.

The only 'one-way' import/export is from the graphics module — which can only be pasted into the word processor (but then where else would you want it?).

Documentation

The documentation included a 390-page manual, a quick reference guide and a 142-page lessons guide. The manual itself assumes no prior knowledge on the part of the user and is thorough in explaining the Mac's procedures. If, however, you are an experienced user, you should just boot up the system and try it. You should only have to refer to the manual for 'fine-tuning'.

Conclusion

One disappointment with Works is the lack of printer spooling — you cannot print one document while working on another one. Any files you have opened up, in addition to the one you are printing, sit in RAM and are completely inaccessible.

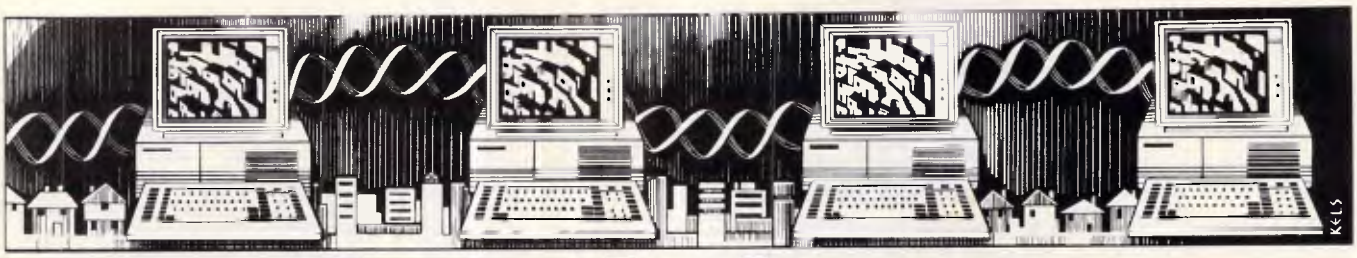
It's also a shame that you can't put graphics in the 'flat-file' database — and that it's not relational — but it should do the job for most simple applications. We would also like to see how the sparse memory management on the spreadsheet works out, as this could be crucial in such a RAM-based product.

We were very pleasantly surprised — by both the power of the software and the price. At $676 it is reasonable for a dedicated single-task application. But for an integrated package with as much power as this, it is excellent.

Even if you need only the word-processing and perhaps the mail-merge facility of the database, Works can probably be cost-justified. This is particularly true now that Apple has 'unbundled' the MacWrite and MacPaint software from the Macintosh Plus.

In our opinion, it's got to be high on every Mac user's wish list.

END



Equal share

Peter Tootill and Steve Withers look at the American concept of sharing your software.

This month we'll devote most of this column to a look at an excellent 'shareware' terminal program for the IBM PC and compatibles called ProComm. This very comprehensive program supports all the usual features such as up and downloading (with a range of protocols), a number of terminal emulations, automatic dial and/or log-on, and so on.

'Shareware' (also called 'freeware' or user-supported software') is an American concept where software is distributed freely via bulletin boards and user groups. Users have the opportunity to try it out and, if it suits them, to register by sending a small fee (usually $25 to $50) to the author. This entitles them to support in terms of notification of future updates, a full (often typeset) copy of the manual, if not already provided on disk, and, most important of all, to continue to use the program. Some shareware software is really powerful and well-produced, and ProComm falls into this category.

Several versions of ProComm are available, but this review is based on the latest we've seen — version 2.3. ProComm requires at least 128k of free memory and runs on the IBM PC, XT, AT or any close compatible. It supports monochrome, composite or colour displays.

In use

There are two different concepts in terminal programs; one type starts with a menu and you select features from it (Crosstalk and Smartcom work this way). The other type takes you directly to terminal mode and a menu is obtained by pressing a particular key. ProComm follows that second pattern.

When you run it, you get a blank screen with the words 'ALT-F10 for HELP' at the bottom. ALT-F10 brings up a list of available commands (see Fig 1) which are available at any time by pressing the relevant key combination — you don't have to display the help screen first. This is a good compromise; experienced users don't have to use the menu screen and those unused to the program always have help at hand.

When you are online, incoming data can be copied to the printer or a disk file. The current screen contents can also be dumped to a disk file. The date, time and time elapsed since the start of the call can also be displayed.

```
ProComm Help

      MAJOR FUNCTIONS          UTILITY FUNCTIONS          FILE FUNCTIONS

Dialing Directory . Alt-D  Program Info ..... Alt-I  Send files ..... PgUp
Automatic Redial... Alt-R  Setup Screen ..... Alt-S  Receive files ... PgDn
Keyboard Macros ... Alt-M  Kermit Server Cmd . Alt-K  Directory ..... Alt-F
Modem Parameters .. Alt-P  Change Directory .. Alt-B  View a File .... Alt-V
Translate Table ... Alt-W  Clear Screen ..... Alt-C  Screen Dump .... Alt-G
Editor ............ Alt-A  Toggle Duplex ..... Alt-E  Log Toggle .... Alt-F1
Exit .............. Alt-X  Hang Up Phone ..... Alt-H  Log Hold ..... Alt-F2
Host Mode ......... Alt-Q  Elapsed Time ..... Alt-T
Chat Mode ......... Alt-O  Print On/Off ..... Alt-L
DOS Gateway ..... Alt-F4  Set Colors ........ Alt-Z
Command Files .... Alt-F5  Toggle CR-CR/LF .. Alt-F3
Redisplay ........ Alt-F6  Break Key ........ Alt-F7
```

Fig 1 PIL Software Systems' ProComm showing the Help menu

Features

ProComm provides most of the features that would be expected of a comprehensive smart terminal program. Fig 1 gives you a good idea of what it can do and below is a brief summary of its most interesting features.

The dialling directory will store up to 100 telephone numbers, each with additional information for baud rate, parity and echo. Each phone number can also have one of four preset long distance prefixes — this is of course irrelevant to Australian users.

As well as the above information, each number can be associated with a 'script' file that is automatically obeyed on successful connection. These files can contain auto-log-on information (more about these below).

The auto-dial prefix can be changed to suit your modem. The default is Hayes type, but others could be used. This should allow ProComm to be used with non-Hayes modems. Suffixes cannot be changed, however, which means that the program could not be made to work with CCITT V22bis modems, unless they will accept a carriage return instead of Control-C. We haven't been able to try this version with a non-Hayes modem.

Ten macros can be predefined and used by pressing the ALT and a number key. This transmits the pre-defined set of characters when you press the keys. At first sight, '10' is not a very generous number, but as you don't need to use

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them for log-on information, it should be adequate.

Translation tables enable any incoming character to be removed or replaced with another. This is useful for filtering out characters that cause problems with your computer. There are no outgoing or printer translation tables.

An 'editor command' loads and runs a word processor or text editor, but doesn't allow a file name to be passed with the command, so you can't use Edlin.

This version of Procomm will also act as a limited 'host' allowing the computer to answer the phone by itself. Callers can download and upload files, chat to the sysop and, if they know the password, have full access to DOS. Optionally callers can be required to enter a password to gain access to the system at all. This is not a full bulletin board system as there is no facility to leave messages.

(Incidentally the chat mode sets up a split screen so that each end of the conversation appears on a different half of the screen. This is available in normal terminal mode as well.)

The DOS gateway enables you to leave ProComm and to perform normal DOS operations or even run another program — even in the middle of a call. Typing 'EXIT' at the DOS prompt brings you instantly back to ProComm with all the parameters and the call intact.

Terminal emulation

ProComm supports the following terminal emulations; VT52, VT100, IBM 3101, Televideo 910/920, 925/950, ADM-3/5m, ADDS Viewpoint, Wyse 100 and ANSI-BBS. As is normal with US software, viewdata (Viatel) is not supported.

Conclusion

ProComm is a versatile and powerful program and, at a registration fee of only $US25 (which can be paid direct to the publishers by credit card) very good value indeed.

ProComm is available from many bulletin boards, users' groups, and direct from the publisher, PIL Software Systems, PO Box 1471, Columbia M065205. The publisher charges $US10 for an evaluation disk which includes a comprehensive 78-page manual, registration is $US25, whichever source you get the program from, or alternatively, for $US50 PIL will supply the software including registration and a printed manual. PIL also runs a FIDO BBS, so if you have an account on a FIDO system, you can contact PIL direct by addressing your mail to node No619, region No14 (14/619).

If you decide to download ProComm from a BBS, be warned that the size of the program, including documentation even in compressed format, is about 180k. The transfer, even at 1200 bits/sec, could take nearly half an hour. At 300 bits/sec it would be a couple of hours!

System News

Half a dozen of Brisbane's sysops have formed a co-operative to simplify the task of collecting subscriptions. The group is called the User Works Network, and comprises ED-RCP/M, BMUG, Hotline, BEX II, Electric Dreams, and Midnight Express. A single payment of $12 per year gives access to all six systems. Subscriptions are due on 1st October, and are pro-rated in other months (e.g. it costs $9 if you join in January).

To become a member, send the appropriate fee and a stamped self-addressed envelope to

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The Magic Pudding (03) 428 2178. Rupert Russell. 7pm-7am daily.

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Motel International (03) 509 9611. P. Kim Gration. 24 hours daily. V21, V22, V22bis, V23.

Profit (03) 529 8749. Andrew Hooper. 24 hours daily. V21, V22, V22bis, V23.

Public Resource #2 (03) 690 7220. P. D Harvey, W Clarke, R Nagy. 24 hours daily.

Videotex 4000 (03) 329 2936. V23 videotex only.

Omega (052) 22 1670. Mark Gregson. 7pm-2am daily.

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Commodore Express (07) 393 5352. Craig Upton.

Communications Interchange (07) 200 7664. Geoff Leff.

Electric Dreams (07) 399 1322. MV. Joe Altoff. User Works Node 5.

Futex (07) 283 2034. Paul Salanitri

Info Interchange (07) 200 7664.

MSL (07) 341 0285.

Rapple-Q (07) 284 6145. Terry Sweetser, G Black, V Crosdale. V21, V22, V22bis, V23.

Telegold (075) 31 6155.

Toowoomba Computer Centre (076) 32 7542. 6pm-8am weekdays, 24 hours weekends.

WA

The Gathering (09) 272 4711. Ken Peters. 24 hours daily. V21, V22, V23.

The Programmers Exchange (09) 274 6851. Matthew Corica. 7pm-7am weekdays, 24 hours weekends.

Updates

NSW

Andromeda. Believed off-line.

Arco-Tel (02) 683 3956. MV. Alex Szx. 24 hours daily. Ausboard. Believed off-line.

Australian Connection. Possibly off-line.

CCBBS. Believed off-line.

Club 80 (02) 332 2494. MV. Michael Cooper. 24 hours daily. V21, V23.

Comet (02) 599 7342. MV. Eric Davis. 24 hours daily. Previously listed as CCUA.

Commodore 64 (02) 664 2334. MV. Graham Lee. 24 hours daily. V21, V23. Previously listed as Commboard.

Computer Connection (02) 528 8968. M. Hamish Bowly. 5pm-9am weekdays, 24 hours weekends.

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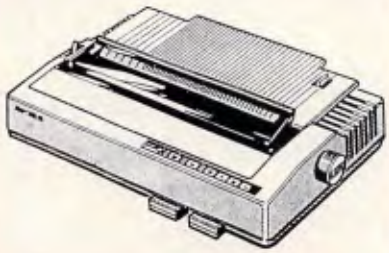

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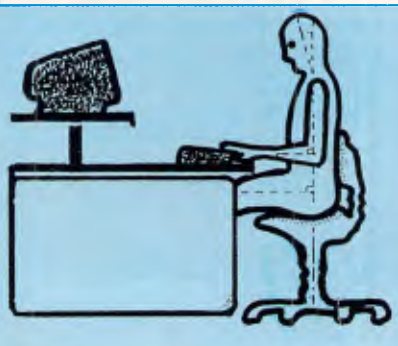

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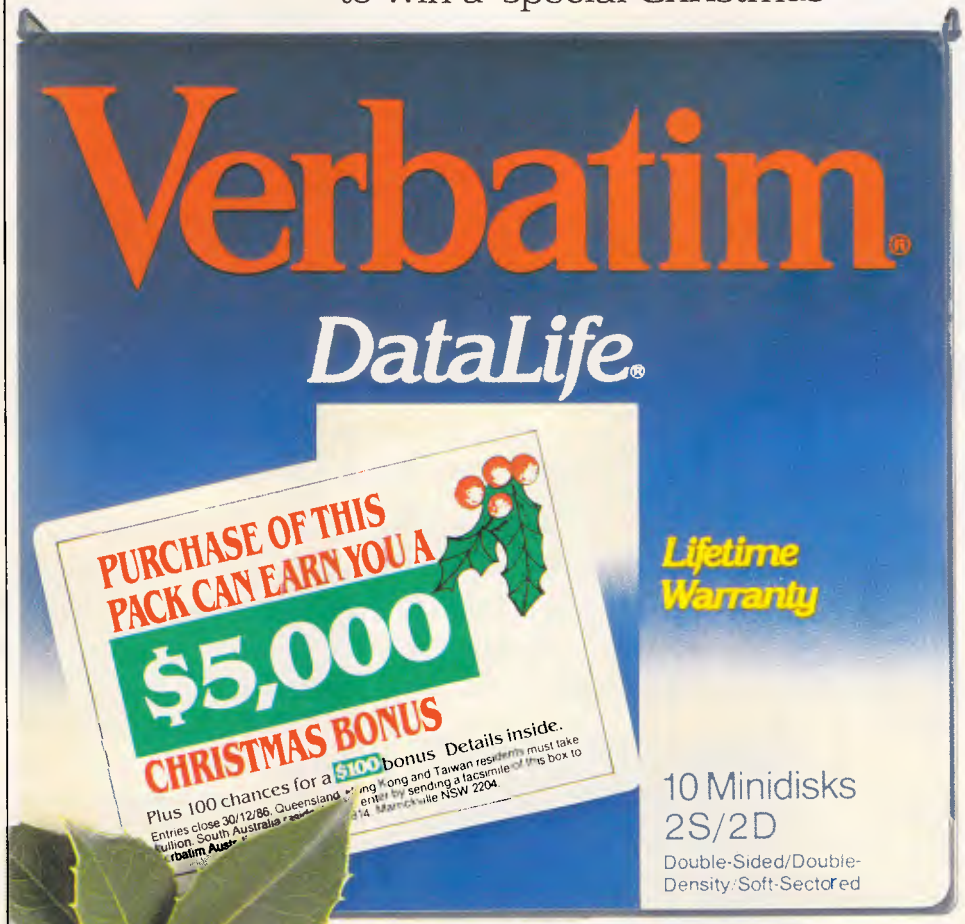

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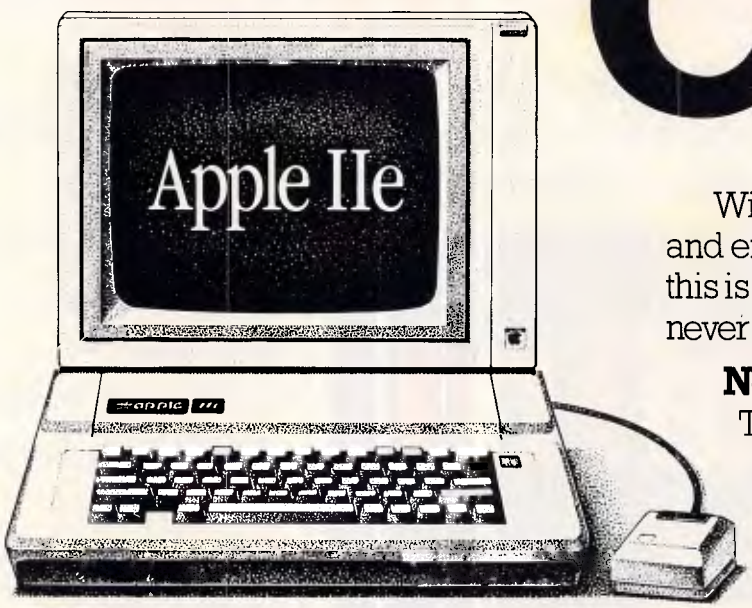

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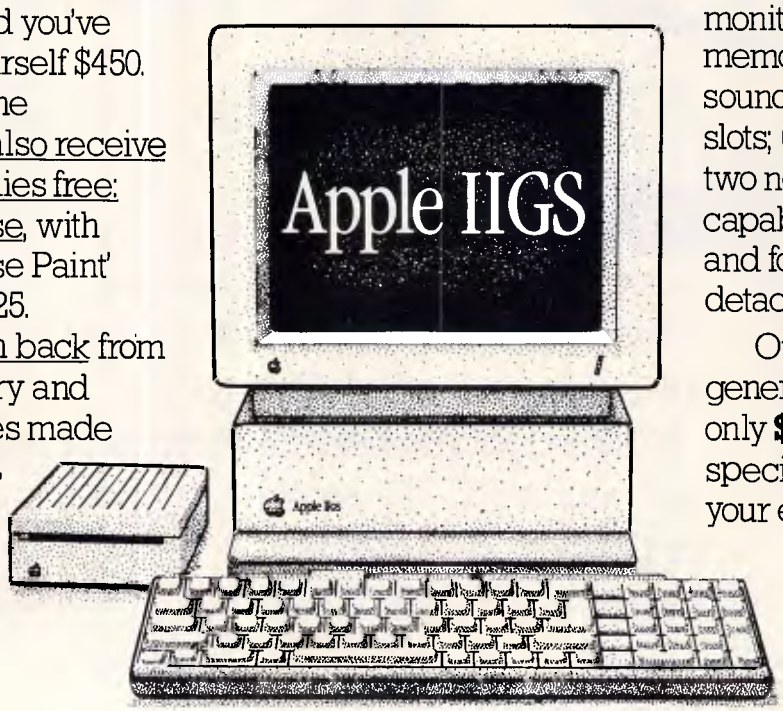

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English for beginners

Leading AI researchers now agree that computers cannot be programmed to be 'intelligent' until significant and serious study is carried out into the fundamental structure and meaning of language itself. Owen Linderholm traces the development of so-called intelligent programs and examines current trends in language study.

A recently released database program called Q & A has one unusual and attractive feature which it refers to as the 'Intelligent Assistant'. The 'Intelligent Assistant' is a front end to the enquiry section of the database and allows you to give requests in plain English, which are then converted and analysed internally. If the program can match the enquiry up to something meaningful, then it produces a report from the records held in the database. An example of a request to the program would be: 'Give me all the Christian names that are Mark.' This produces the full names from all records in the database where the first name is Mark. If the program has had problems, then you can give more help with whatever part of the request puzzled it.

Since the above program is only meant to work in the context of a database, it is naturally limited and it is easily confused. Indeed, as with all current natural language programs, it can often be difficult to make yourself understood at all if you don't know the specialised vocabulary required.

Another recent program that has caused a stir in quite different circles is 'The Pawn'. This is an adventure game of the sort where you have to explore a magical fantasy land and solve a mystery. The program relies heavily, as do many adventure games, on understanding text input from the user and reacting to it. A typical request to the program might be: 'Pick up the chest and look inside it.' Because the writers of such programs are generally pedantic, the usual response from the program would be: 'You get the chest. You cannot do that' (meaning look inside). The reason for this reply is that the program has not been told that you wanted to open it before looking inside. A response showing more understanding would be: 'You get the chest. You cannot find any way to open it.' Although The Pawn understands a surprisingly large range of requests and can cope with extremely complicated sentences, it does have some glaring weaknesses and too often produces the familiar 'I don't understand' and 'What?' of all adventure game parsers.

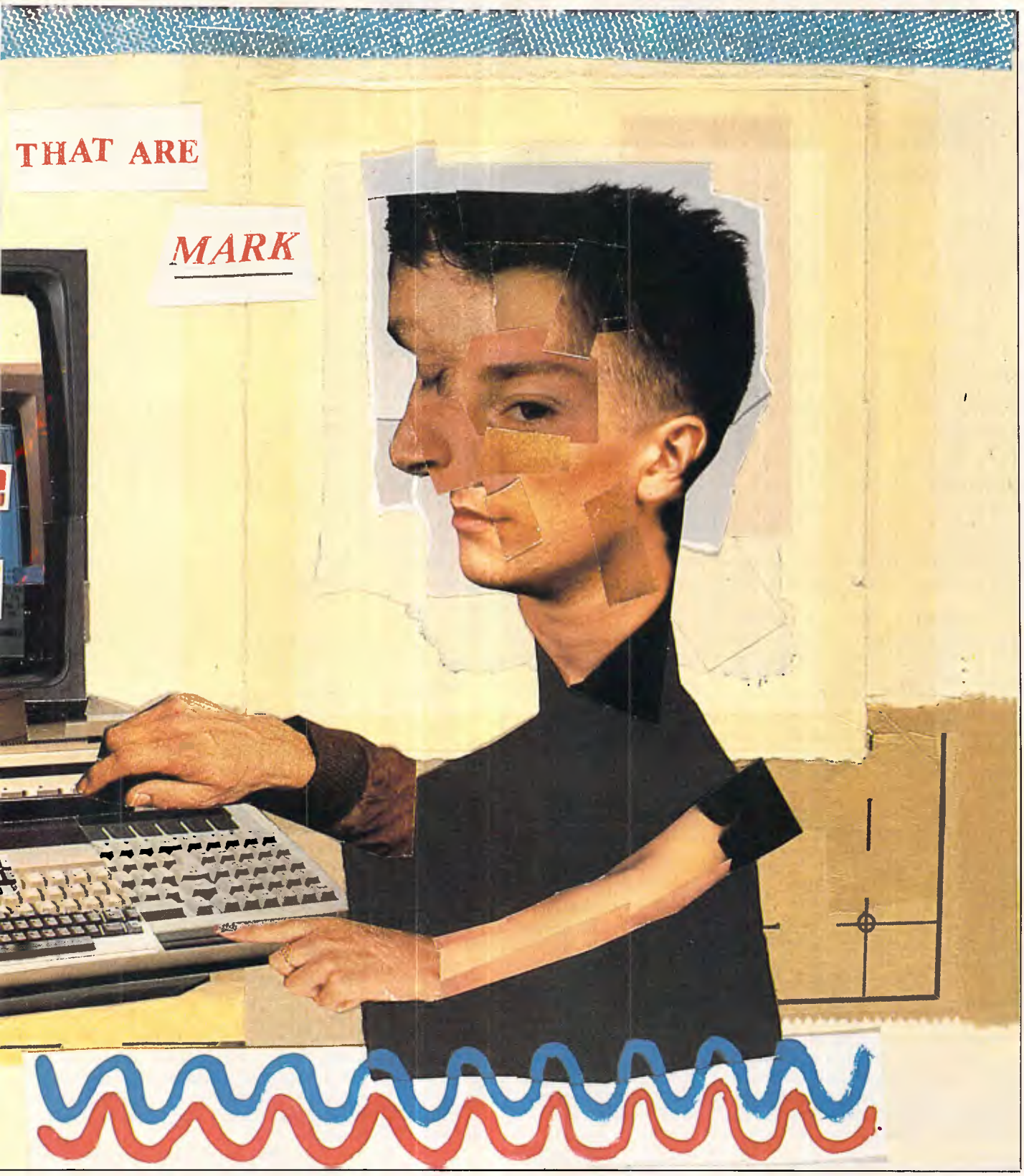
Both of the above described programs show a level of language understanding that can surprise people who are not aware of how they work; they can also show a remarkable ability not to understand depending on the actual words used. This situation reflects the current state of research into natural language understanding and arises because of the way such programs are written.

History

The most famous program in natural language understanding is also one of the oldest. It is, of course, ELIZA written by Joseph Weizenbaum. The program was never intended to really understand what was said to it, but to react in a manner similar to a Rogerian psychotherapist.

In this form of psychotherapy, the therapist reacts to what has been said by trying to obtain more information. This leads to a very bland, although logical conversation, but one that has fooled many into thinking that real understanding lies behind the program.

In fact, the program works on the keyword principle. By using a list of important words which it then



associates with other words, it attempts to produce a meaningful response. An example is:

USER: I'm a bit worried about my mother.

ELIZA: Tell me more about your family.

In this case, the keyword 'mother' has been connected with 'family' to produce a reply that is reasonable. But the program has its shortcomings, one of which is:

USER: I want to destroy my mother.

ELIZA: Your mother?

Although this response does make sense, a more detailed conversation would reveal that the only word ***reacted*** to in the above sentence is 'mother'. The program has not even ***considered*** what 'destroy' means.

Weizenbaum was horrified when he discovered how seriously some people took his program. When he got his secretary to use the program, she even asked him to leave the room since what she was discussing was private! A very good account of the significance (and

lack of it) that has been attributed to his program is given in his excellent book, *Computer Power and Human Reason,* which provides a very cogent analysis of the dangers of taking AI research too seriously.

Another program from the same period is PARRY, a conversational simulation of a paranoid. This program employs a pattern-matching strategy where input is checked for certain words or phrases that can be answered as part of the program's paranoid responses. Other inputs are treated very noncommittally. Once an input has been given, the program starts off on a chain of responses designed to produce more input leading toward more paranoid behaviour. The language patterns that the program can recognise are quite subtle. For instance, many inputs that indicate some form of apology can be ignored if the program has not had its fear and anger thresholds raised. On the other hand, if the program is already 'suspicious', an apology can result in an aggressive outburst, to which any reply could produce more paranoia and anger.

The program is also able to steer conversations onto subjects, such as the police or the mafia, about which it has strong paranoid 'feelings'. Almost anything wrong is blamed on one of these two groups and, once mentioned, it is easy for the conversation to revolve around them, continually increasing the program's 'anger' and 'suspicion'.

Both the above programs rely strongly on matching patterns of text to a very limited base of knowledge about the world. Any input that doesn't match this knowledge results in an innocuous phrase or question, 'fishing' for a more suitable input. Another sort of pattern matching is also used. The phrase 'I hate ice cream' might be used to generate a reply such as: 'Why do you hate ice cream?', simply fitting a word identified as a noun into a template to produce a response that makes sense.

Both of these programs made little, if any, use of the research that had been done in theoretical linguistics. The major advances in this area came from Noam Chomsky's ideas on grammars and the structure of language which became dominant in the mid 1960s.

The idea behind Chomsky's work is that the structure of the meaning of a sentence does not necessarily resemble the structure of the original words, but is instead based on a deeper structure that conveys more about the way words depend on each other. These deeper structures can then be manipulated by transformations and changing the order without affecting the original meaning. Alternatively, such transformations can be used to analyse the meaning more closely so as to construct a more logical structure.

Chomsky's grammar structures are mathematically based so that they can be used as a basis for theorems and proofs about language, but they are not really suited to human language, which is inconsistent and comparatively ill-defined. Nevertheless, a great deal of his work on the syntax of language is important, since it was the first scientific approach to analysing language and introduced the idea that the structure of a sentence is not necessarily best represented superficially.

It is now generally accepted that a sentence should be broken down into separate parts that can be put together, generally as a tree structure, to represent meaning.

From this change in the way of representing sentences and their meaning, came a great deal of research into ways of modifying the underlying structures to change and analyse meanings. One of the major ideas was the *case frame.* This is based on the idea that a word like 'bicycle' shouldn't be represented as a noun, or even the subject or object of a verb, but as the agent or instrument in something happening. A phrase such as 'David rode the bicycle to the shops' would then be analysed into:

David — agent (instigator of action)
rode — action/relation (what was done)
bicycle — instrument (what was used to perform the action)
shops — object-recipient (what, who or why the act was taken).

A case frame is the information about a word that is known, and indicates what else has to happen around the word. For example, the case frame for bicycle would show that it needed an agent and an action.

A method for writing grammars to recognise syntax was developed in the late 1960s making use of the idea of case frames. This was the augmented transition network (ATN) which has been widely used since. An ATN represents a grammar as a set of diagrams or networks showing the possible syntax of a sentence and all the options available at any point. Each part of the set has options leading out of it representing some change in parsing, leading to another part of the set. The parser then starts at a defined point and runs through the sentence a word at a time, performing the indicated action at each point until the sentence is parsed successfully or a failure results. In effect an ATN is a complex, finite state machine, which can be thought of as a very specialised flow chart, manipulating structures.

The program that has perhaps had the greatest effect on natural language research is Terry Winograd's SHRDLU. This manipulates an imaginary world of children's blocks according to instructions given to it. The program shows remarkable understanding within its own little world, and was regarded for a time as a significant breakthrough in machine understanding. Nevertheless, it is still severely limited in one major way. Even within the world of blocks, it has very little understanding of what is involved in what it has to do. Because the program is based around an imaginary world, it has no understanding of the real world. If the program were connected to a robot arm and were asked to manipulate a real set of coloured blocks, it would find the task impossible despite managing the theoretical task quite well. The reason is that it has no concept of things such as weight, distance and shape. All it really knows are names, relative positions and grammatical constructions, but within its own limited area SHRDLU behaves well, as the following example demonstrates.

Imagine a table holding a variety of coloured blocks: boxes, cubes, cuboids and pyramids. Among the blocks is a large cuboid on top of which is the tallest pyramid on the table, a small cube and a green pyramid on the small cube. When asked: 'Does the shortest thing the tallest pyramid's support supports support anything green?', SHRDLU replies correctly: 'Yes, the green pyramid.'

In fact this is a relatively simple example. The program also remembers everything it has been asked to do and can be queried on what has been done, as in: 'Did you touch any pyramid before you put the green one on the little cube?' followed by: 'When did you pick it up?', both of which are understood and answered correctly.

Terry Winograd *now* believes that computers cannot really understand

'The biggest problem in understanding natural language is "meaning". People themselves cannot adequately define meaning, despite some of the world's greatest philosophers having cogitated on the problem.'

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language and that a very different approach is needed. He says that SHRDLU (written in 1970) was based around a theory of meaning which was far too simple and excluded the possibility of intelligent behaviour. This is explained in a recent book, *Understanding Computers and Cognition,* written with Fernando Flores, which also covers his latest theories on language.

Since that time there have been changes leading towards an approach based on semantics (meaning) rather than syntax (grammar and form). The major difference is that it is believed that far more real-world knowledge is required before a computer can understand language. Evidence that this is true can even be seen when comparing SHRDLU with the earlier ELIZA or PARRY, both of which seem to understand more than SHRDLU, especially when dealing with topics about which they know nothing despite SHRDLU's undoubted superiority in deciphering complicated syntax.

Two of the main ideas that have come out of more recent research are frames (of reference) and scripts. Instead of trying to match words and syntax as PARRY and ELIZA do, more recent programs attempt to match the underlying meaning to permissible sequences of action or events in order to understand them. This approach has been applied by R C Schank to understanding simple short stories. The basis of this approach is that often, people automatically add-in unsupplied information about the expected course of events in a story or explanation from their own knowledge of the world.

The main conclusion to be drawn from recent changes in natural language understanding is that the whole subject is more difficult than had been anticipated. One recent trend is toward 'parsers' which may not necessarily be interesting theoretically but which are reasonably robust and work adequately in the environment for which they are intended. The front end to Q&A mentioned above is a good example. A great deal of research is still going on, but much more is being carried out into specific areas within natural language understanding, something along the lines of 'learning to crawl before learning to walk'.

Grammar lesson

Syntax or lexical analysis is concerned with the structure and grammar of sentences without taking meaning into account. It is usually regarded as the first step in processing natural language. One fairly common view is that full syntactic analysis is not necessary to understand natural language. Let's examine the following sentence: 'Sarah lit the fire.' If enough is known about the meaning of the words in the sentence, then it doesn't really need to be analysed for verbs, nouns, and so on. After all, the fire can only be lit and Sarah is the only one to do it. Nevertheless, without syntactical analysis of some sort, a program might take 'The fire lit Sarah' to mean the opposite, instead of (perhaps) taking the phrase to mean that Sarah became visible in the glowing firelight.

The purpose of syntax analysis and parsing is to take an input sentence or phrase and make a structure from it. A simple example is to find subject, object and verb within any sentence. To do this, some sort of structure for language is necessary and, not surprisingly, this is known as grammar. This is operated on, fairly independently, by the parser, a program which builds up a structure from the sentence based on the grammar. The output of the parser can be in almost any form depending on the theoretical basis being used to understand the language. The structure usually produced, however, is either a tree of some sort or a network.

Grammars are almost always based on the phrase structure grammars described by Noam Chomsky. These are very theoretical and mathematically-based and merit far deeper coverage than I can give them in this article. Basically, phrase structure grammars consist of sets of symbols further divided into initial symbols, terminal symbols, non-terminal symbols and pre-terminal symbols. All possible words, word structures and phrases are described in terms of these symbols and rules connecting them together. A very simple example is:

Sentence —› Phrase
Phrase —› Phrase Conj Phrase
Phrase —› Nounphrase Verb Nounphrase
Phrase —› Nounphrase Verb
Nounphrase —› Nounphrase Conj Nounphrase
Nounphrase —› Article Adjective Noun
Nounphrase —› Article Noun
Adjective —› red
Adjective—› blue
Article —› the
Verb —› chase
Verb —› like
Noun —› rat
Noun —› cat
Noun —› Jill
Noun —› Jack

It is possible with this grammar to construct or parse sentences such as 'Jack and Jill like the cat and the rat.' There is one problem, however, to do with declensions of the verbs. When the subject of one of these verbs is singular, the verb should have 's' added to the end. This can be made part of the grammar with difficulty or can be dealt with by a special routine for the cases of verbs. For example, 'Jill chases Jack' can be broken down into a phrase, then a nounphrase followed by a verb followed by a nounphrase and then each of these can be broken up further within the grammar above to produce the structure shown in Fig 1.

Parsing can be done in either direction, from the words through to the structure, or from the structure through to the words. The decision is which way to go; top-down or bottom-up is usually a function of the details of the grammar, just use whichever seems easiest.

Once the structure has been decided and the grammar is known, writing a parser is not too difficult, but there are several innocent-seeming but very dangerous pitfalls. An example can be produced from the seemingly correct grammar above. 'The cat chases and the cat chases the cat' doesn't really make sense, but it is a very straightforward, correct sentence produced by the grammar. Even worse to consider is 'The cat chases the cat chases . . . the cat', with an infinite number of cats chasing is equally correct.

This illustrates one of the hardest of these pitfalls to track down; recursive definition within the grammar. This can be any number of steps long and if it occurs, and is ever reached by the parser, results in an infinite loop. It can be a very easy point to overlook but a very difficult one to eliminate.

Meaning

The biggest problem in understanding natural language is 'meaning'. People themselves cannot adequately define meaning, despite some of the world's greatest philosophers having cogitated on the problem. Nevertheless, much of the *meaning* within language is understood easily by people, if only at a fairly instinctive level.

For example, English language comprehensions at school are designed to test how well a piece of writing has been understood. If the basic meaning of all the passages were in question, then it would be very difficult to use them as the basis for examinations. Not surprisingly, because of our lack of theory in the area of meaning and semantics, research into computer understanding based on a semantic approach is proceeding very slowly.

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MAIL ORDER: (03) 543 7877 or P.O. Box 620, CLAYTON 3168

WHOLESALE INQUIRIES: Ritronics Wholesale, 56 Renver Rd. CLAYTON 3168. Phone (03) 543 2166.

FREE POSTAGE FOR ORDERS OVER $75 & UNDER 3kg!!

FREE POSTAGE FOR ORDERS OVER $75 & UNDER 3kg!!

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FREE POSTAGE FOR ORDERS OVER $75 & UNDER 3kg!!

FREE POSTAGE FOR ORDERS OVER $75 & UNDER 3kg!!

IBM* XT & AT COMPATIBLE EXTENDED KEYBOARD (105 KEYS)

These new keyboards are both XT and AT compatible!
- 20 Dedicated function keys
- Enlarged "Return" and "Shift" key
- Positive feel keys
- Low Profile Design, DIN standard
- Separate Numeric and Cursor control keypads
- Additional Functions... Key-in-lock, Audio Beep, Previous Word, Next Work, Fast Repeat, Line Feed, Pause, Clear Screen, Reset.

Cat.X12022 ..... **only $249**

"IBM* AT TYPE" KEYBOARD

- 100% IBM* PC, XT compatible
- Low profile keyboard dasign
- Proper placement of shift keys with large key tops to suit professional typists.
- 3 step height/angle adjustment
- Cherry brand TS-M00001 19mm low profile switches, meet 30mm ergonomic requirement and provides high performance and maximum reliability.
- Curl lead plugs straight into PC/XT
- 3 Status displays

Just like the "Real McCoy" only at a fraction of the price!

Cat.X12020 ..... **only $149**

IBM* XT COMPATIBLE CARDS

NEW TURBO CARD!
Make your XT work as fast as an AT! (Up to 9 times faster)
Cat. X $995

Enhanced Graphics Card
Cat. X $499

High Resolution Colour/Graphic/Mono/Printer
Cat. X $395

640K Main Board
Cat. X18020 ..... $249

Turbo Mainboard
Cat. X18030 ..... $295

Mono Graphic Printer Card
Cat. X $175

Colour Graphic Display Card
Cat. X $129

384K Multifunction Card
(includes cable, but not RAM)
Cat. X $199

Multi I/O and Disk Controller Card
(Includes cable)
Cat. X $199

Floppy Disk Controller Card
(2 drive capability)
Cat. X18005 ..... $79

Floppy Disk Controller Card
(4 drive capability)
Cat. X $99

Parallel Printer Card
Cat. X18017 ..... $37.50

RS232 Card
Cat. X18026 ..... $59.50

Clock Card
Cat. X $59.50

Games Adaptor Card
(2 joystick ports.)
Cat. X $39.50

Hard Disk Drive Card
Cat. X $299

NEW!!

D LINK NETWORK CARDS

Complete with software. Also runs PC-NET*. 1M/Bit per second data transfer rate via 2 wire link. Dedicated server not necessary. Up to 255 stations.
..... **$695**

TEXTOOL SOCKETS

P17016 16 pin **$14.50**
P17024 24 pin **$14.50**
P17028 28 pin **$19.50**
P17040 40 pin **$22.50**

TELECOMMUNICATION EXTENSION LEADS

Cat. Y16010 5m **$12.50**
Cat. Y16012 10m **$14.95**

TELEPHONE CURL CORD

- U.S. plug to U.S. plug
- Replacement hand set cord
- Length 4.5 metres

Cat. Y16023 ..... **$7.95**

Ho!

TELEPHONE ADAPTOR

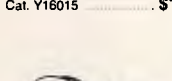
- Australian plug to U.S. sockat
- Lengih 10cm
- Cream colour cable

Cat Y16026 $6.95

TELECOMMUNICATIONS AUSTRALIAN STYLE ADAPTOR CABLE

- Australian socket to plug/socket
- Length 10 metres

Cat. Y16015 ..... **$15.95**



U.S. TELEPHONE EXTENSION CABLE

- U.S. plug to 2 U.S. sockets
- Length 10 metres

Cat. Y16028 ..... **$10.95**

U.S. TELEPHONE EXTENSION CABLE

- U.S. plug to U.S. socket
- Length 10 metres

Cat. Y16024 ..... $8.95

TELECOMMUNICATIONS AUSTRALIAN TO U.S. ADAPTOR CABLE

- Australian socket to U.S plug.
- Length 5 metres.

Cat. Y16017 ..... **$7.95**

CENTRONICS GENDER CHANGERS

- Female to Female.
- Saves modifying or replacing non-mating Centronics cables.
- All 36 pins wired straight through.

Cat. X15660 **Male to Male**
Cat. X15661 **Male to Female**
Cat. X15662 **Female to Female**
Normally $33.95.
Our Price $24.95

RS232 GENDER CHANGERS

- Saves modifying or replacing non-mating RS232 cables.
- All 25 pins wired straight through

Cat. X15650 **Male to Male**
Cat. X15651 **Male to Female**
Cat. X15652 **Female to Female**
Normally $19.95 each
Our Price $14.95

RS232C NULL MODEM ADAPTOR

- Male to female connections
- Pins 2 and 3 reversed
- All 25 pins connected

Cat. X15657 **Male to Male**
Cat. X15658 **Male to Female**
Cat. X15659 **Female to Female**
Normally $22.95
Our Price $14.95

RS232 MINI PATCH BOX

- Interface RS232 devices
- 25 pin inputs
- 25 leads with tinned end supplied
- Complete with instructions

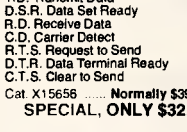
Cat. X15653 **Male to Male**
Cat. X15654 **Female to Male**
Cat. X15655 **Female to Female**
Normally $25.95
Our Price $19.95

RS232 MINI TESTER

- Male to female connections
- All pin wired straight through
- Dual colour LED indicates activity and direction on 7 lines
- No batteries or power required

T.D. Transmit Data
D.S.R. Data Set Ready
R.D. Receive Data
C.D. Carrier Detect
R.T.S. Request to Send
D.T.R. Data Terminal Ready
C.T.S. Clear to Send

Cat. X15656 ..... **Normally $39.95**
SPECIAL, ONLY $32.95



RS232 INLINE SWITCHING BOX

- 25 pin "D" plug to 25 pin "D" socket
- DIP switches allow easy switching of internal wiring.

Cat. X15662 ..... **$32.95**

IC SPECIALS!

	1-9	10+	100+
5558pin	0.50	0.40	0.35
4116	$3.95	$3.75	$3.50
4164	$3.95	$3.75	$3.50
2716	$8.90	$8.50	$8.30
2732	$8.25	$7.95	$7.50
2764	$6.25	$5.95	$5.00
27128	$6.95	$6.50	$6.25
6116	$2.95	$2.75	$2.50
41256	$5.95	$5.50	$4.95
6264	$6.50	$5.50	$5.25
27256	$11.50	$10.50	$10.00

WORLD MODEM CHIP

Cat. U21614 Normally $49.50
Save $20, SPECIAL $24.95

MEL9501

Have you blown up your Apple drive by plugging it in backwards or not turning off the power while changing bauds? We have the MEL9501 chip!
SPECIAL, ONLY $29.95

SPEECH SYNTHESISER CHIPS!

SPO256A-AL2: Speech synthesiser chip, needs programming to work.
..... **$16.95**

CTS256-AL2: Contains the code recognition circuit to enable the project to plug directly on the printer port, or into an IBM PC.
..... **$29.95**

A SET OF EACH . $44.95

IC STORAGE CASE

Electro static charge proof plastic IC case with conductive sponge. Dimensions: 75 x 130 x 19mm.
Cat. H10095 ..... **$8.95**

APPLE COMPATIBLE CARDS!

PRINTER CARD
"Grappler" style card allows hi-resolution screen dumps to your Epson compatible printers. Fully functioned for flexible flow of output.
Cat. X17029 **$89**

80 COLUMN CARD
Ideal for use with CP/M. Your computer becomes capable of upper and lower case, with a full width screen of 80 characters. If you want to run Wordstar, or any good wordprocessing software, get this card.
Cat. X17019 **$85**

SPEECH CARD
Simple to use, software controlled speech synthesiser kit. Complete with demonstration programs and text to speech software. Impress your friends with your talking Apple!
Cat. X17009 **$69**

MUSIC CARD
Three channel synthesiser can create a single polyphonic output or three monophonic outputs. Control of pitch and volume is possible. Up to three cards can be used at the one time. Complete with demonstration software.
Cat. X17011 **$99**

RGB CARD
True high definition colour for your Apple or compatible.
Cat. X17039 **$79**

P.A.L. COLOUR CARD
Get some colour into your games. Use your Apple or compatible on the second television. Has both UHF and composite video outputs. Fully adjustable so you can fine tune it for a crisp clean image.
Cat. X17025 **$95**

SUPER SERIAL CARD
No card does it better. Want to hook in to bulletin boards or mainframes? Turn your computer into a dumb terminal. That's right! This serial card comes complete with software.
Cat. X17035 **$129**

APPLE IIe COMPATIBLE CARDS

80 Column/64K Card X17061 $89

TELEPHONE EXTENSION CABLE UNIT

Allows 15 metres of telephone extension cable to be neatly wound into a protable storage container. The reel sits on a flat base and has a handle to wind cable back on to it after use. No tangles - no mess! Ideal for the workshop, around the house, office, pool etc.
Cat. Y16013 ..... **$24.95**

Ho!

JOYSTICK FOR IBM

Features Selectable "Spring centering" or "free floating". Electrical trim adjustments on both axis. 360 degree cursor control
Cat. C14205 ..... **$49.95**

APPLE JOYSTICKS

Ideal for games or word processing. Fits most 6502 "compatible" computers.
Cat. C14200 ..... **$39.95**

DELUXE JOYSTICK

Suits Commodore 64, VIC 20, Atari, Sears, NEC PC-6001 computers or video games.
Cat. C14220 ..... **$14.95**

DB CONNECTORS

Cat. No.	Description	Price
P10880	DE9P Male	$1.95
P10881	DE9S Female	$2.25
P10882	DE9C Cover	$1.20
P10884	DE9P R.A. Plug	$3.65
P10885	DE9S R.A. Skt	$4.25
P10890	DA15P Male	$2.10
P10891	DA15S Female	$2.25
P10892	DA15C Cover	$1.25
P10894	DA15P R.A. Plug	$4.25
P10895	DA15S R.A. Skt	$5.00
P10900	DB25P Male	$2.75
P10901	DB25S Female	$2.95
P10902	DB25C Cover	$1.25
P10904	DB25P R.A. Plug	$4.50
P10905	DB25S R.A. Skt	$5.95

COMPUTER LEADS

CL2
- 9 pin 'D' plug to 9 pin 'D' plug
- All pins wired straight through (removable terminals)
- Length 1.5 metres

Cat. P19033 **$14.95**

CL3
- 9 pin 'D' plug to 9 pin 'D' plug
- All pins wired straight through (removable terminals)
- Length 3 metres

Cat. P19035 **$17.95**

CL5
- 9 pin 'D' plug to 9 pin 'D' socket
- All pins wired straight through (removable terminals)
- Length 3 metres

Cat. P19036 **$17.95**

CL7
- 15 pin 'D' plug to 15 pin 'D' plug
- All pins wired straight through (removable terminals)
- Length 3 metres

Cat. P19016 **$24.95**

CL8
- 15 pin 'D' plug to 15 pin 'D' socket
- All pins wired straight through (removable terminals)
- Length 3 metres

Cat. P19017 **$27.95**

CL10
- 25 pin 'D' plug to 25 pin 'D' plug
- Pins 1 through to 8 and 20 wired straight through (removable terminals)
- Length 1.5 metres

Cat. P19011 **$26.95**

CL11
- 25 pin 'D' plug to 25 pin 'D' plug
- Pins 1 through to 8 and 20 wired straight through (removable terminals)
- Length 3 metres

Cat. P19009 **$23.50**

CL12
- 25 pin 'D' plug to 25 pin 'D' plug
- Pins 1 through to 8 and 20 wired straight through (removable terminals)
- Length 7.5 metres

Cat. P19037 **$25.95**

CL13
- 25 pin 'D' plug to 25 pin 'D' socket
- Pins 1 through to 8 and 20 wired straight through (removable terminals)
- Length 3 metres

Cat. P19020 **$29.95**

CL21
- 25 pin 'D' plug to 25 pin 'D' plug
- All pins wired straight through (removable terminals)
- Length 1.5 metres

Cat. P19007 **$33.95**

CL22
- 25 pin 'D' plug to 25 pin 'D' plug
- All pins wired straight through (removable terminals)
- Length 3 metres

Cat. P19008 **$41.95**

CL23
- 25 pin 'D' plug to 25 pin 'D' socket
- All pins wired straight through (removable terminals)
- Length 3 metres

Cat. P19012 **$42.50**

CL25
- 36 pin Centronics plug to 36 pin Centronics plug
- All pins wired straight through
- Length 2.13 metres

Cat. P19014 **$49.95**

CL27
- Apple II, IIe, II+, with parallel interface card
- Dual 10 pin (20 contacts) connector to Centronics 36 pin plug
- Length 2.4 metres

Cat. P19025 **$29.95**

CL28
- Apple III with universal parallel interface card
- Dual 10 pin (20 contacts) on Apple end to Centronics 36 pin plug
- Length 2.4 metres

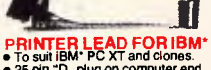
Cat. P19026 **$29.95**

CL30
- Tandy II/12/16/16B/2000, with dual 17 pin female on computer end to Centronics 36 pin plug. (Equivalent to 26-1323)
- Length 2.4 metres

Cat. P19027 **$33.95**

CL31
- Tandy I/III/4/4P, with 34 pin edge connector on computer end to Centronics 36 pin plug. (Equivalent to 26-1401)
- Length 2.4 metres

Cat. P19028 **$37.95**



PRINTER LEAD FOR IBM*

- To suit IBM* PC XT and clones.
- 25 pin "D" plug on computer end to Centronics 36 pin plug
- Length 2 metres

Cat. P19029 ..... R.R.P. $44.95
SPECIAL, ONLY $19.95

JUMBO 5¼" DISK STORAGE

If you've got lots disks, you'll appreciate the extra capacity of this disk storage unit when it comes to locating "that" disk!

Features...
- 100 disk capacity
- Smoked plastic cover
- Lockable (2 keys supplied)
- 9 Dividers/spacers

Cat. C16027 ..... **only $24.95**

5¼" DISK STORAGE

Efficient and practical. Protect your disks from being damaged or lost!

Features...
- 50 disk capacity
- Smoked plastic cover
- Lockable (2 keys supplied)
- Dividers/spacers

Cat. C16030 **only $19.95**

3½" DISK STORAGE UNIT

- Holds up to 40 x 3½" diskettes
- Lockable (2 keys supplied)
- High impact plastic lid and base

Cat. C16035 ..... **only $19.95**

DATA CASSETTES

Save a small fortune with these quality 20 minute tapes. We import direct so we can pass on the savings

Cat. D11141

1-9	10+	25+
$1.20	**$1.10**	**$1.00**

DIRECT IMPORT FLAT IDC RIBBON CABLE

1-29m	30-59m	60+m
14 Way Cat. W12614		
$1.90	**$1.80**	$1.70
16 Way Cat. W12616		
$1.90	**$1.80**	$1.70
20 Way Cat. W12820		
$2.50	**$2.20**	$2.00
24 Way Cat. W12624		
$2.90	**$2.70**	$2.60
25 Way Cat. W12625		
$3.20	**$2.90**	$2.70
26 Way Cat. W12626		
$3.60	**$3.10**	$2.90
34 Way Cat. W12634		
$3.90	**$3.60**	$3.40
36 Way Cat. W12636		
$3.90	**$3.60**	$3.40
40 Way Cat. W12640		
$4.90	**$4.40**	$4.20
50 Way Cat. W12650		
$5.90	**$5.40**	$5.10
60 Way Cat. W12660		
$6.90	**$6.40**	$6.10

COMPUTER PAPER

Quality paper at a low price! 2,500 sheets of 11 x 9½ 60 gsm bond paper.

Cat. C21001 Normally $44.95

SPECIAL, ONLY $37.95

Ho!

PAPER TAMER

- Restores ordar to the top of your dask or work area
- Mada of white plastic coated staal
- Stores up to 900 continuous sheets
- Allows perfact paper fead
- Allows aasy examination of print out

..... **$44.95**

(Printer and paper not included)

CANON A-40 PRINTER

- Saral Impact Dot Matrix
- 140 C.P.S
- Near Lattar Quality Mode
- 1.4K Buffer

Cat. C20040 ..... **$525**

2 & 4 WAY RS232 DATA TRANSFER SWITCHES

If you have two or four compatible devices that need to share a third or fifth, then these inexpensive data transfer switches will save you the time and hassle of constantly changing cables and leads around.
- No power required
- Speed and code transparent
- Two/Four position rotary switch on front panal
- Three/Five interfaca connections on raar panal
- Switch comas standard with famala connactor

2 WAY Cat.X19120 ..... **$125**

4 WAY Cat.X19125 ..... **$145**

2 & 4 WAY CENTRONICS DATA TRANSFER SWITCHES

Save time and hassles of constantly changing cables and leads around with these inexpensive data transfer switches. These data switches support the 36 pin centronic interface usad by Centronics, Printronics, Data Products, Epson, Star, Micronics, and many othar printer manufacturers.
- No power raquired
- Speed and coda transparent
- Two/Four position rotary switch on front panel
- Three/Five interfaca connections on rear panal
- Switch comes standard with female connactor
- Bale locks are standard

2 WAY Cat.X19130 ..... **$125**

4 WAY Cat.X19135 ..... **$145**

RS232 SURGE PROTECTOR

- Avoids costly damaga from large voltage peaks caused by lightning or other power problams
- Uses metal oxide varistors (M.O.V.) to suppress any voltage above 26V on pins 2,3 and 7.
- Will handla up to 1 Joule and 250A peak current.

Cat. X15660 ..... **$34.95**

SAMSUNG TTL MONITOR

A quality 12" TTL monitor, with a high contrast, non-glare screen at a vary raasonabla price!

SPECIFICATIONS:

Picture Tube: 12" diagonal 90° daflaction
Phosphor: Green (P39)
Mode: TTL
TTL Input Signal:
Polaarity: TTL Positive
Level: 4V p-p +−1.5V
Impedance: 750hm
Active Video Period:
Horizontal: 44.25 uS maximum
Vertical: 18.98 mS maximum
Video Band Width: 16 MHz (−3dB)
Scanning Frequency:
Horizontal: 18.432 +−0.1KHz
Vertical: 50 HZ +−0.5%
Active Display Araa:
216(H) x 160(V)mm
Display Characters: 80 characters x 25 linas
Input Connector: 9 pin connector
Controls:
Front: Power ON/OFF, Contrast.
Rear: V-Hold, V-Size, Brightness
Intarnal; Vartical Linearity, Horizontal Linaarity, Horizontal Width, Focus.

Cat. ..... **only $199**

Ho!

TTL MONITORS

Fantastic resolution! Enjoy a crisp, sharp image with the latest Ritron TTL monitor! IBM* compatible, green display, swivel and tilt base.

Green Cat. X14510 **Normally $289**

Amber Cat. X14512 **Normally $289**

SPECIAL, ONLY $269

SAKATA HIGH RESOLUTION COLOUR MONITOR

High quality IBM compatible monitors, great with VCR's too!

SPECIFICATIONS:
CRT: 13", 90° deflection colour
Input Signal:
Video Signal: Separate video signal
Video: Positive
Sync.: Positive
Input Level: TTL Level
Scsnning Frequency:
Horizontal: 15.7KHz
Vertical: 60Hz
Display Size: 245(H) x 182(V)mm
Resolution:
Horizontal: 640 dots
Vertical: 200 lines
Size: 343(H) x 362(W) x 421(D)mm
Waight: 11.6kg

..... **$695**

RITRON 2 MONITORS

Stylish, swivel base monitor available in amber or green.

Green Cat. X14506 **Normally $235**

Amber Cat. X14508 **Normally $239**

SPECIAL, ONLY $199

IBM* COMPATIBLES from $895*

Assembled & Tested in Australia!

Incredible deals to suit everyona including special packaga deals! *256K RAM, singla drive, graphics, and disk controller cards. **$895**

256K RAM: Colour Graphics, Disk Controllar Card, 1 parallel port, 2 disk drives and 3 months warranty. **only $1,195**

640K RAM: Colour graphics, Multifunction Card, Disk Controller Card, 2 serial and 1 parallel ports, 2 disk drives and 3 months warranty. **only $1,295**

IBM* AT COMPATIBLE!

Assembled & Tested in Australia!
- 6 MHz
- 80286 CPU
- 8 slots
- 1 M/Byte main board
- 1.2 M/Byte Floppy disk drive
- 20 M/Byte Hard disk
- Colour graphics display card
- Floppy and Hard disk controllar card
- Printer card and RS232
- 200W Power supply
- Keyboard
- Manual

All this for just $3,995

(Monitor not included)

ANTI GLARE SCREEN

Half the price of other brands!

Relieve eye strain and haadaches and increase productivity with these Anti Glara Screens. Suitabla for 12" monochrome and colour monitors.

Cat. X99995 ..... **$24.95**

SWIVEL BASE

Make life easier with these quality, swivel and tilt bases, complete with rubber fittings!

Cat. O11100 ..... **only $24.95**

RS232 DATA SWITCH WITH TESTER

- No power required
- Ideal for 1 computer to 2 peripherals or 2 computers to one peripheral.
- 25 pin RS232 "D" connectors.
- Six dual coloured LED indicators showing certain flow status:

T.D. Transmit Data
R.D. Receive Data
R.T.S. Request To Send
C.T.S. Slear To Send
D.S.R. Data Set Ready
D.T.R. Data Terminal Ready

- Size: 200(W) x 68(H) x 150(D)mm

Cat.X19110 ..... **R.R.P. $169**

Our Price $149

IBM* COMPATIBLE DISK DRIVES

Tired of paying up to 100% more for Japanese Disk Drives? We now have "direct import" Taiwanese disk drivas at much lower prica!

Cat.No.	Description	Price
C11801	500K	**$199**
C11803	1 M/Byte	**$239**
C11805	1.6 M/Byta	**$259**

APPLE* COMPATIBLE SLIMLINE DISK DRIVES

Japanese Chinon mechanism,

Cat. X19901 Normally $225

NOW $195

20 M/BYTE HARD DISK DRIVE FOR IBM* AND COMPATIBLES

Includes hard disk controller card.

Cat. X20010 ..... **WAS $1,250**

SPECIAL, ONLY $995

*IBM is a registered trade mark.

RITRON MULTI PURPOSE MODEM

The RITRON Multi Purpose Modem has all the features you require...
- CCITT V21 300 Baud Full duplex
- CCITT V23 1200/75
- Bell 103 300 Full duplex
- Bell 202 1200 Half duplex
- Auto answer, auto disconnect.

Telecom Approval No. C84/37/1134

Cat. X19103 Normally $399

SPECIAL $299

1200/75 BAUD RATE/BIT CONVERTER

For computers not capable of split baud rates. Buffers characters at 1200 and converts to 75 baud

Cat. X19105 **$99**

BRAND NEW FANS

Quality, new fans for use in power amps, computers, hotspot cooling etc. Anywhere you need plenty of air.

240V	4⅝"	Cat. T12461	**$14.95**
115V	4⅝"	Cat. T12463	**$14.95**
240V	3½"	Cat. T12465	**$14.95**
115V	3½"	Cat. T12467	**$14.95**

10+ fans (mixed) only $10 each!

FAN GUARDS TO SUIT

4⅝"	Cat.	T12471	**$3.95**
3½"	Cat.	T12475	**$3.95**

rie

Rod Irving Electronics

48 A'Beckett St, MELBOURNE
Phone (03) 663 6151

425 High St, NORTHCOTE
Phone (03) 489 8866

Mail Order and Correspondence:
P.O. Box 620, CLAYTON 3168

Telex: AA 151938

MAIL ORDER HOTLINE
008 335757
(TOLL FREE)
(STRICTLY ORDERS ONLY)

LOCAL ORDERS & INQUIRIES
(03) 543 7877

POSTAGE RATES:

$1	$9.99	$2.00
$10	$24.99	$3.00
$25	$49.99	$4.00
$50	$99.99	$5.00
$100	$199	$7.50
$200	$499	$10.00
$500 plus		$12.50

FREE POSTAGE FOR ORDERS OVER $75 & UNDER 3KG!!

The above postage rates are for basic postage only. Road Freight, bulky and fragile items will be charged at different rates.

Certified Post for orders over $100 included free!
Registered Post for orders over $200 incuded free!

All sales tax exempt orders and wholesale inquiries to: RITRONICS WHOLESALE, 56 Renver Rd, Clayton. Ph. (03) 543 2166 (3 lines)

Errors and omissions excepted

*Apple and IBM are registered trade names

MasterCard VISA

FREE POSTAGE FOR ORDERS OVER $75 & UNDER 3kg!!

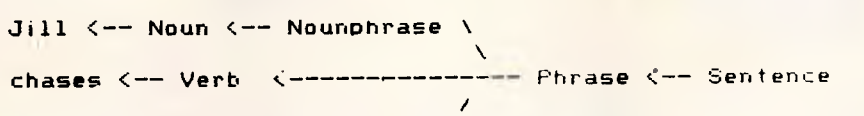


Fig 1 Sentence breakdown to show structure

The mainstream approach is that an underlying theory for meaning is necessary. There are two standard ways of designing a theory. The first is essentially mathematical and tries to make a mathematical system describe the meanings of text. This is seen as an advantage because it allows rigorously defined procedures to be used and allows theories about meaning to be proved completely. Unfortunately, English is not very suited to such a description and it is difficult to force it into the mathematical mould.

The second approach is to invent a notation for meaning in English and invent rules for connections. This approach is much more flexible and allows the minimum of description to be used. Unfortunately, it is all too easy to get confused and pursue paths that are full of errors. It is also impossible with this method to prove that something is right.

The former method essentially uses predicate or symbolic logic. This is also used as the basis for expert systems and essentially boils down to logical statements and inferences of the 'x is y, y is z, therefore x is z' kind. I don't have the space to do the subject justice here, but many of the books listed in the Bibliography at the end of this article contain excellent examples. Less work is done along these lines because most people believe that a system of logical inference is not really suitable for a description of meaning. It definitely has uses as a method of extracting more meaning from within a description, but is simply too inflexible to be of much use for description and representation themselves.

The alternative to a predicate logic is more popular. The largest part of it is to design a structure for representing meaning. Starting at the bottom, one approach is to use semantic primitives. These are indivisible units of meaning, something along the lines of atoms. The idea is that any idea or meaning can be split up and represented in terms of these primitives, an example of which can be taken from the sample language syntax given in Fig 1.

Given here is a simple example but it does give some idea of the possibilities.

Jack	Object
Jill	Object
cat	Object
rat	Object
like	Action
chase	Action
red	Description
blue	Description
the	Null

Listed here are the basic primitives that apply to the words in the sample grammar. In a more complex language they would have a wide range of other primitives associated with each of them. For example, *chase* might have a primitive 'Movement' associated with it while *like* might have 'Emotion' associated with it. Some simple rules could then be set up for this 'language'.

An object may have a description attached to it. Every action must have an object that performs it and an object on which it is performed.

Using these simple primitives and criteria, the sentence 'The rat chases Jill' would have an action with the necessary two performing and performed objects and would thus be regarded as having meaning. In the same way 'The cat red likes Jack' would be seen as nonsense since a description has been applied to a verb. Of course, the rules would have to be more carefully formulated and some form of pre-processing such as simple syntax analysis would be necessary. The grammatically incorrect sentence above would have been caught by a syntax checker as previously described, so perhaps a *better* error would have been 'The cat chases the rat likes Jill' which would easily have passed the syntax checker as previously described, so rigorously checked but they do illustrate the point).

The representation of a sentence is generally done by a semantic network. This is because more common data structures such as trees are too inflexible to cope with most semantic forms. A network or graph is simply a data structure which can connect information at 'nodes' or intersections in any way. This means that a word like 'red' could be connected to the word it describes, 'ball', as well as primitives like 'Description' and 'Colour'. Data structures such as these, although flexible, are extremely difficult to manipulate, and cause their own problems to do with searching for and cross-referencing information.

One approach to solving this problem and creating some sort of organisation is the frame concept. The thinking behind this is that an area of information, data and procedures relating to some wider topic could be seen within the same frame of reference and so grouped together, accessed together and generally be moved about together. This idea is based upon humans having chunks of knowledge about certain situations ready to apply to any situation that seems appropriate. This avoids having to work out everything all the time but instead only call upon a section of information when it is deemed necessary. Some form of controlling process is needed to decide when to access a frame and this is generally performed by a routine that is called only when a certain set of criteria has been satisfied.

Understanding

Most of the research carried out so far in natural language understanding is rather vague; nevertheless, what has been done provides a great deal of information about what not to do and what areas seem worthy of further study. Some of the more significant and impressive work is being done within more limited areas than all language. One area of study is understanding simple stories.

Two approaches are taken to this. One is that of scripts. In this approach a story is either generated from one of many simple scripts, outlining a simple plot and the sort of story elements that may be used, or an attempt is made at understanding a simple story using the same technique. This allows research into meaning and understanding to go on in a simplified environment, thus reducing the complexity and problems involved. For example, if the allowed area of discussion is reduced via a script to a world of woods, walking, bears and birds, then it is possible to make a more detailed analysis of the meaning that a seemingly simple verb like 'to be' can have.

Another area of research is *motivational analysis.* Recognising the intention and implied assumptions behind a sentence or phrase is extremely important in order to properly understand it. This is generally analysed by specifying possible goals which could be achieved and then working out which

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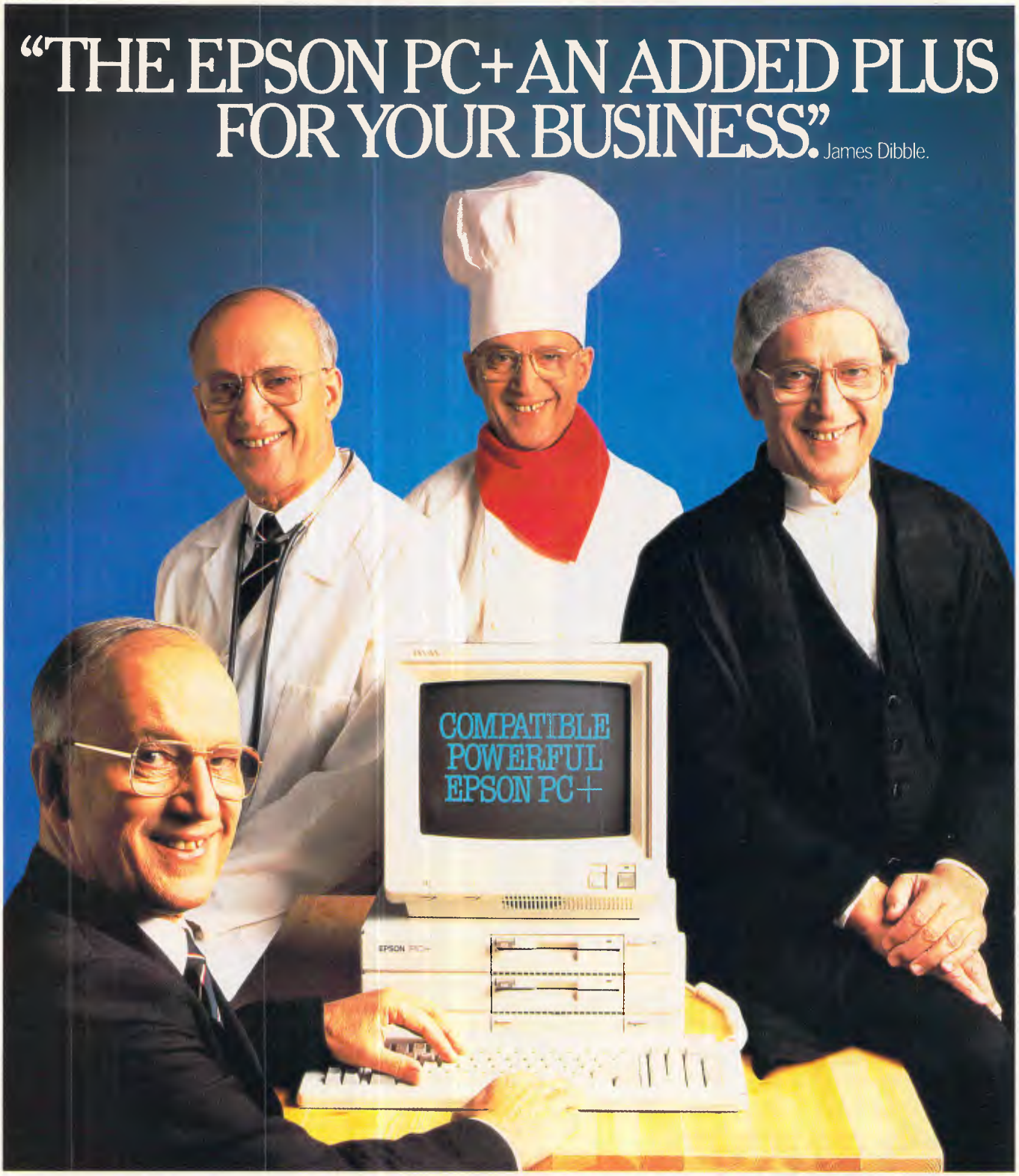

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one or ones are involved. The goals to be achieved are reduced and simplified by splitting them up into sub-goals that are easier to identify. A simple example might be: 'Mrs Jones arrived in Sydney half an hour later.' Further understanding might then require some knowledge of how Mrs Jones got to Sydney. There is no evidence to show this, but if you knew that she had previously been in Newcastle, then it wouldn't be hard to deduce that she must have flown.

If we assume that the computer has a database of knowledge about travel and about the geography of New South Wales, then computer reasoning might be as follows.

Mrs Jones travelled from Newcastle to Sydney.

Mrs Jones' journey took half an hour.

Therefore Mrs Jones travelled from Newcastle to Sydney in half an hour.

Sydney is a fair way from Newcastle.

To travel a fair way in half an hour requires great speed.

Mrs Jones could have driven, caught a bus, caught a train, walked or flown.

Only flying requires great speed.

Therefore Mrs Jones flew.

The computer has achieved its objective by breaking the problem into sub-problems and analysing the answers. The trick is to devise a knowledge/meaning structure that can relate all the above information and allow it to be broken down step by step. If the computer were asked to solve the problem in one go, it would have to spend far too much time searching within its knowledge structure, slowly widening the connections it made until it reached the answer. In the real world this would take a long time, so motivational analysis allows the problem to be broken into manageable steps and provides a sensible and meaningful way of tackling the problem.

Conversation

One area of language that has not been covered is 'conversation'. A spoken sentence or phrase can have several meanings ranging from statements, that may or may not be true, questions, to utterances indicating some sort of action. These are described as speech acts and are considered generally to involve actions of asking and commanding. For example, 'Get the door' could be a command or a request depending on context, but its relation to a physical action is rather complicated. Often in language, such a speech act is used to indicate that an action has taken place or will take place without referring to it directly. Once this is recognised, it is possible to deal with speech acts within language by the addition of a few more semantic primitives and some more rules.

The real world

The goal of any research into computer understanding of language is eventually to produce a system that can understand or *seem* to understand textual input to it. Although this goal may seem abstract, it can have real purpose. One example is in teaching computers about the real world. At the moment, knowledge is stored in computers in database structures that are designed by people and have information fed into them laboriously by people. If a computer could simply have text fed into it and then understand it and sort it out itself, then a great deal of drudgery associated with maintaining computer systems could be eliminated. This is just one example of the sort of thing that could be done; it is not hard to think of others.

The problem is that research is still at the stage where the fundamental problem has not been properly defined or understood. Until it is, or some approximation seems good enough, then no great strides forward can be made. What is needed is a selection and combination of the available techniques and those yet to be developed that covers all the possibilities — and still manages to work.

The major problems encountered are: interpretation of words or phrases; how to treat the balance between analysing the form of words and their content; the complexities of syntax and difficulty of constructing an error-free grammar; how to deal with the huge varieties of ambiguity that can occur; and how to deal with text that just does not fit in with any rules available — the last of which is a perfect example of how far research still has to go. If people have difficulty discovering the meaning behind such famous words as: 'That the world is, is the mystical' (Wittgenstein), it's not hard to imagine the trouble poetry could cause computers!

Of the problems listed above, ambiguity is the one most studied. This is not surprising, because there are several levels of ambiguity in language, many of which go unnoticed because people automatically glean understanding from context and further elucidation. Ambiguity to do with context, such as having the pronoun 'it' refer back to an object other than the last one mentioned, is often ignored by humans because only one possibility makes sense. This sort of ambiguity (referential) must also be sorted out by the computer using meaning.

Another common form of ambiguity is in what individual words actually mean. Some information about this can be gleaned from syntax, but again, information about the context and overall meaning is often necessary. In the sentence 'I watched him case the joint', a syntax checker could decide that case was a verb here, not a noun. However, in 'She studied the book', it is not clear whether the book is one to read or the form guide to a horse race. Most people would assume the former, probably correctly, based on knowledge of the real world, but there is no guarantee that they would be right. It is hard to see how anyone could expect a computer to differentiate between the two.

Conclusion

What is happening in commercial programs at the moment is that large compromises are being made in order to get a program that will work within a given environment. Nevertheless, such programs still require some getting used to and are only useful in very limited cases. It would perhaps even be fair to regard them as not much more than gimmicks. The usual compromise taken is to severely limit the vocabulary used and the accuracy with which translations are made. This allows the programs to operate with acceptable speed.

As computers slowly gain in speed and power, it will be possible to do more, but the limiting factor will almost certainly be the speed at which improvements in programs can be made. The dream is to produce an electronic machine, that can understand speech, differences in dialect, and so on, and that will provide you with a wide range of knowledge and even advice almost instantaneously. I don't expect to see one working in my lifetime, but I'd like to be proved wrong.

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PC-Eighty

Phil Cohen looks at an Australian product which allows MS-DOS-based machines to run CP/M. Sounds strange? Read on . . .

Remember CP/M? It started way back when microcomputers were the domain of boffins only, and the only people that used them in an office were futurologists. CP/M was developed, like a lot of operating systems in those days, by a lone designer to fill a need of his own. It grew in size, complexity and following from that point on, to provide the basic ideas, and a lot of the traditoins, that led to MS-DOS.

CP/M also gained a solid reputation for user-unfriendliness. Error messages like 'BDOS Error on A:' abound. To copy a file from one disk to another in a single floppy machine, you had to load the file into memory using the debugger, at the same time noting on a piece of paper the size of the file in decimal, then exit the debugger, convert the number to hex, put the other disk in, enter the first two digits, (I think) in a command like SAVE 99 FILE, cross your fingers and whistle the national anthem.

Although the early versions of CP/M (running on 8in floppies only) were interchangeable, later versions (for 5in systems) were totally incomprehensible to each other. There are literally hundreds of different disk formats for CP/M, almost as many versions as there are machines. Even on the same machine, different versions of CP/M worked in different ways, and it wasn't unusual to have to call in a programmer to get even the most commercial of packages running. As a standard, CP/M was a failure.

But for all that, it attracted the growing number of backroom boys and girls who were interested enough in computers to *prefer* an operating system that made you think.

Out of those years of fertile CP/M soil and equally fertile minds came an enormous outpouring of software to suit the most vertical of vertical markets. CP/M software must be almost as varied as Apple software (of which there is an awful lot) – and of course by adding a board to the Apple you could run CP/M on *it* too!

The upshot of all of this is that whatever your application (beekeeping? escort agency management? stock car racing?) someone out there has written a package to run it under CP/M.

For a good number of years I owned an Apple II+ computer which, by dint of having a special card fitted, could run CP/M. In the fast-moving world of microcomputing, what surprised me more than anything else was the fact that, once you had an application, (mine was word processing) up and running, there was precious little reason for upgrading to a bigger or better machine. Once I was happy with all of the printer formats, standard files and backup procedures I had set up, I could see no reason to change. Until the IBM PC and MS-DOS came along. Then I bought a clone.

There must be a lot of people who have old CP/M machines running old applications, who would dearly like to upgrade to MS-DOS but couldn't face the difficult period of adjustment. I was lucky – as most of what I write is published and then forgotten, I didn't have to worry about porting files from the Apple to the clone. But for other applications – in particular databases and vertical market software – it would definitely be easier to just keep the old workhorse running.

For a while now the NEC V20 chip has been available. This is a clever little device which is plug-compatible with the 8088 (there's also a version called the V30 which is compatible with the 8086). It runs 8088 code without a hitch – in fact, there's one in my clone now, as I write this article under MS-DOS. But as well as being an 8088, the V20 is also an 8080 – the processor that runs CP/M.

Why Intel didn't do this in the first place (now that NEC has shown that it's possible) is a mystery to me. I suppose it wanted to cut the knot from the 8080 in order to clear the way for the 80286, 80386 *et al.* Anyway, by gingerly taking the 8080 out of your machine and replacing it with a V20 you can convert your MS-DOS-only PC into an MS-DOS *and* CP/M machine.

So far, so good. But what about actually getting that old CP/M software onto your PC? That's not so easy – especially since there are all those hundreds of different CP/M disk formats.

But only recently an Australian company called FBN Software has developed a package that comes complete with a V20, which solves the whole sticky problem in one hit. The package is called PC-Eighty.

Installation

The PC-Eighty package contains a disk with the software, a 30-page manual and a V20 chip in its own plastic container. The first thing you have to do (after having backed up the software, which the manual wisely tells you to do first) is to change your CPU.

Now, for those of you who have never removed a 40-pin IC from its socket and replaced it with another, I can tell you that it is not particularly easy. Throughout the whole process you will be conscious of the fact that you are performing, (literally) open-heart surgery on your PC. In order to do this, you must really want to run CP/M software, or write reviews like this one. The process involves covering a table with aluminium foil and grounding it to a water tap. Always, by the way, use the cold water tap for this – the hot tap might not be earthed.

It also involves a very tricky bit of manoeuvering with a small screwdriver in a confined space, plus gently bending 20 pins at a time of an expensive IC so that they would fit a socket. However, once accomplished, you need never tackle it again.

In fact, there is a possibility that unbeknown to you, your PC already contains a V20 chip. Alternativley, it may contain an 8086, which means that you need a V30 instead. I suggest that you find this out before you start taking the chip out. Especially since, if your PC does have an 8086 you will have to buy your own V30, as FBN does not supply them. (They will, however, give you a refund on that unwanted V20 – I think they're worth about $20 each).

Of course, if you have an AT-

```
FDCopy Version 1.0b
Copyright (c) 1986 FBN Software, Australia

CP/M Disk Formats Supported:                    (Page 1 of 7)

 1 PC-Eighty Format SS          14 AMPRO (type 1) SS (96 TPI)
 2 PC-Eighty Format DS          15 AMPRO (type 1) DS (96 TPI)
 3 Abacus DS (96 TPI)           16 AMPRO (type 2) SS
 4 Actrix AM SS                 17 AMPRO (type 2) DS
 5 Actrix AM DS                 18 AMPRO (type 2) SS (96 TPI)
 6 ADDS Multivision DS          19 AMPRO (type 2) DS (96 TPI)
 7 Adler Alphatronic P3         20 Amstrad CPC 464 SS
     DS (96 TPI)                21 AMUST Exeuctive
 8 Adler Alphatronic DS             (Early) DS (96 TPI)
 9 Adler Alphatronic SS         22 AMUST Executive DS (96 TPI)
10 Adler TA/ScreenTyper DS      23 Archive DS
11 Altos DS (96 TPI)            24 Archive DS (96 TPI)
12 AMPRO (type 1) SS            25 Associate DS
13 AMPRO (type 1) DS            26 Avatar TC10 DS

Use Function Keys to select new page ± or enter number of required
format:
```

The FDCOPY utility supports nearly 200 CP/M disk formats.

```
C >
C >
C >cd \pc80

C >pc80

PC-Eighty version 1.0b
Copyright (c) 1986, FBN Software, Australia

CP/M Version 2.2
Copyright (c) 1979, Digital Research Corp

CPU Type: NEC uPD70108 (V20)
Floppy Disk — Drive A; 320K
RAM Disk — Drive B: 512K
Terminal Emulation: Lear Siegler ADM31

A >
```

From MS-DOS to CP/M with a single command!

```
A >
A >
A >dir
A: EXIT   COM : CLSANSI   COM : CLSADM31   COM : EXTEND   COM
A: QSUB  COM : PC       COM : PC    SWP : PC                    OVL
A >
A >
A >
A >exit

Terminate CP/M and return to DOS (Y/N)? y
C >dir /w

Volume in drive C is HARDDISK C
Directory of C:\pc80

.                ..              CPM      PC80        COM         SETUP COM
FDCOPY     COM
       6 File(s)     1216512 bytes free

C >
```

Directory in CP/M — then back to MS-DOS.

compatible you might as well forget the whole thing, because no-one has produced an equivalent to the V20 for the 80286 chip.

Running CP/M software

Having installed the hardware (ie, your new CPU), you then have to install the software. Now, this is not as simple as it sounds, particularly if you do not have a CP/M machine *and* a copy of CP/M itself handy. I found this out when I first tried to get the product working. When I came to the part in the manual that said "if you do not have [CP/M saved as a file] you can generate one on your eight bit machine ..." I suddenly realised that I needed a CP/M machine to get the product to work.

So before you buy PC-Eighty, make sure you have access to a CP/M machine and a copy of CP/M that both fit the CP/M software you want to run. I asked someone at FBN why they didn't just supply a copy of CP/M with PC-Eighty and they said that Digital Research, the holder of the CP/M copyright, wanted a lot of money for it. Seems reasonable – but be warned that you need that CP/M machine.

Having got your hands on the CP/M machine, you have to do some real old-fashioned CP/M jiggery-pokery to get CP/M onto a file. Having done that, you load onto your MS-DOS machine a piece of software called FDCOPY, supplied with PC-Eighty, which lets your MS-DOS machine read any of a couple of hundred different CP/M disk formats.

Now, to my mind that's half of the battle over. FDCOPY lets you read data files from CP/M disks and convert them into readable MS-DOS files. That alone would be worth the price of the whole package. FDCOPY also lets you copy files from MS-DOS to any of those formats, and even allows you to FORMAT blank CP/M disks. So in principle, you could even use FDCOPY as a means of passing CP/M files between different CP/M machines.

FDCOPY, like the rest of the software in the package, is very well put together, with a thoughtfully-designed user interface. I have a couple of minor quibbles about the COPY command – which is deceptively similar in operation to the MS-DOS COPY, but not similar enough to actually do what I thought I was telling it to do – but all in all the whole thing works smoothly. The other little disappointment was that one of the few formats it couldn't read was Apple – so all of my old Apple files will have to stay where they are. Of course, FBN is the company that brought you PC-Alien, which is

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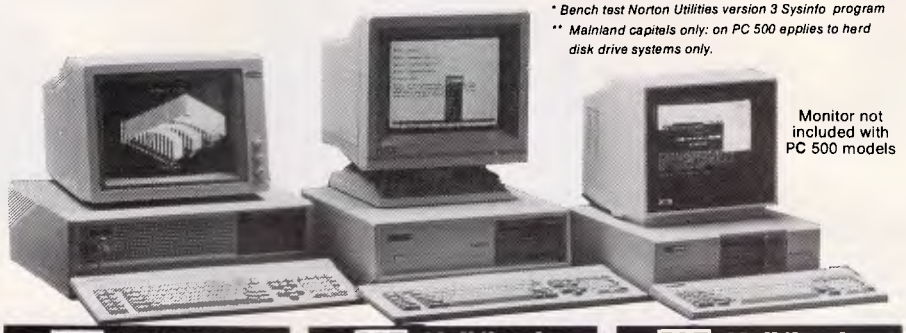

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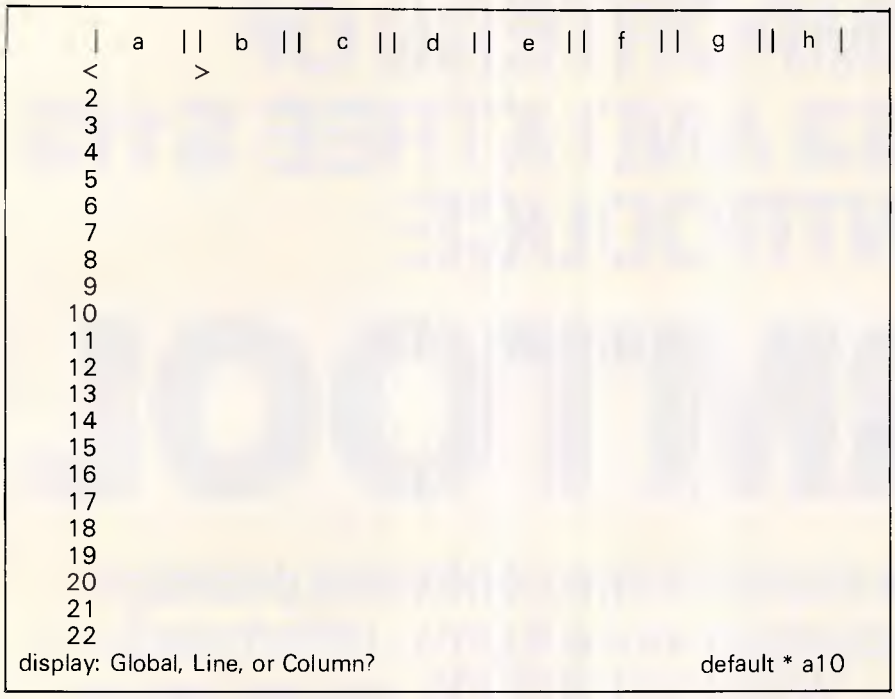

CP/M PerfectCalc running on an IBM PC clone.

obviously the backbone of FDCOPY. PC-Alien does, in fact, just what FDCOPY does, and has been sold as a separate product for some time. In fact, if you're thinking of buying PC-Alien, take a look at PC-Eighty instead.

After you have copied CP/M itself, and the software you want to run, onto your PC, you are just about ready to roll. First, you have to install CP/M into the PC-Eighty software itself. The SETUP program supplied with PC-Eighty does this –it actually reads CP/M and copies it into part of a file called PC80, which holds the rest of the initialisation software.

SETUP also allows you to choose which type of terminal emulation you want – either Lear Seigler ADM-31 or an ANSI standard one like a DEC VT-100. And if you want to use a hard disk, SETUP will let you select two files which CP/M will treat as two separate hard disks. To MS-DOS each file will look just like any other MS-DOS file, except that they will expand when CP/M puts something into them. But to CP/M each of the files will look like a complete CP/M hard disk, capable of holding up to 8 Mbytes (or the capacity of the real hard disk, whichever comes first).

Because CP/M can only handle 64k of RAM (only 64k? Yes – that was a lot a few years ago) the rest of your system's RAM appears to CP/M as one giant RAM disk, which should speed up your applications no end.

Of course, the serial and parallel ports at the back of your machine are also accessible from CP/M. All in all, PC-Eighty is a very nice implementation, and is perhaps an indication of what CP/M might have turned into with cheap hardware and no MS-DOS.

Along with the PC-Eighty software itself, there are a couple of useful CP/M utilities. The first, and most important, of these is EXIT, which takes you back to MS-DOS from CP/M.

There are also a couple of little routines to clear the screen in either of the two terminal emulation modes. A program called EXTEND alters the running of CP/M so that the user number and drive letter are both shown in the prompt (like this: 'A0>'), and searches user area 0 for .COM files if they are not found in the current user area. This is as close as CP/M gets to having directories. FBN has also thrown in a little routine called QSUB which allows you to run more than one command in a list without putting them in a file and running SUBMIT (the CP/M equivalent of a batch file).

Actually running CP/M after all that is a bit of an anti-climax. The only excitement (apart from seeing a lot of very old software running) was getting PC-Eighty to run at all. A bug – which FBN assures me will be fixed before anymore are sent out – meant that the whole thing dies when you try to run it with any memory-resident software installed. You nearly got this review next month.

Prices

FBN is selling PC-Eighty for $140, which includes a V20 processor. For that price you get the $20 processor, plus $100 worth of software in the form of a renamed PC-Alien, plus the utilities which allow you to actually run CP/M usefully. To my mind, that's a bargain.

Conclusion

There is a lot of CP/M software around. Much of it is cheap, and some of it (public-domain software) is free. There are advertisers in a number of magazines who for a nominal fee will send you a whole disk full of public domain CP/M software.

If you have a very vertical application (rat breeding? Venezuelan tax law advice? review writing?) then there may well be a piece of software around that does *just* what you want. Or you could be the type of person who just likes playing with obscure software (I know I do). In either case, PC-Eighty makes possible in a single package what otherwise could only have been produced by a vast amount of messing around. And it was developed – and is supported – in Australia.

END

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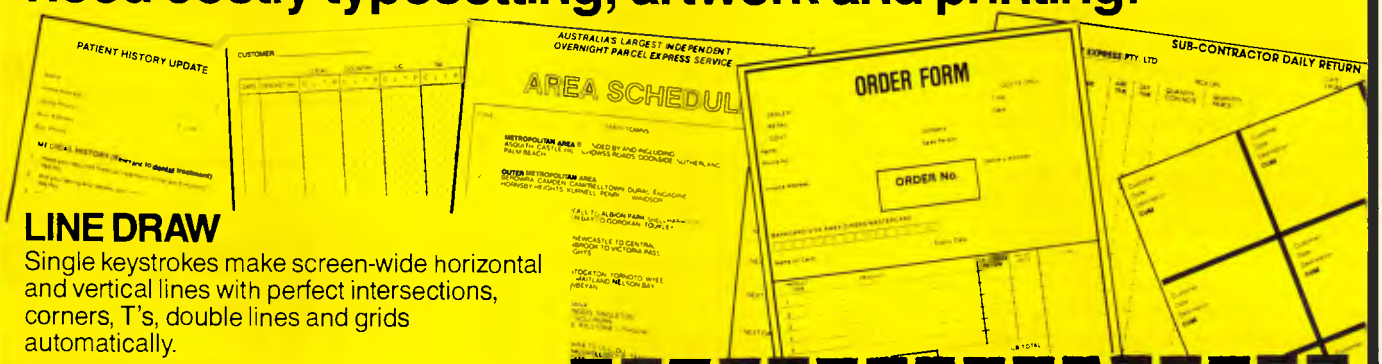

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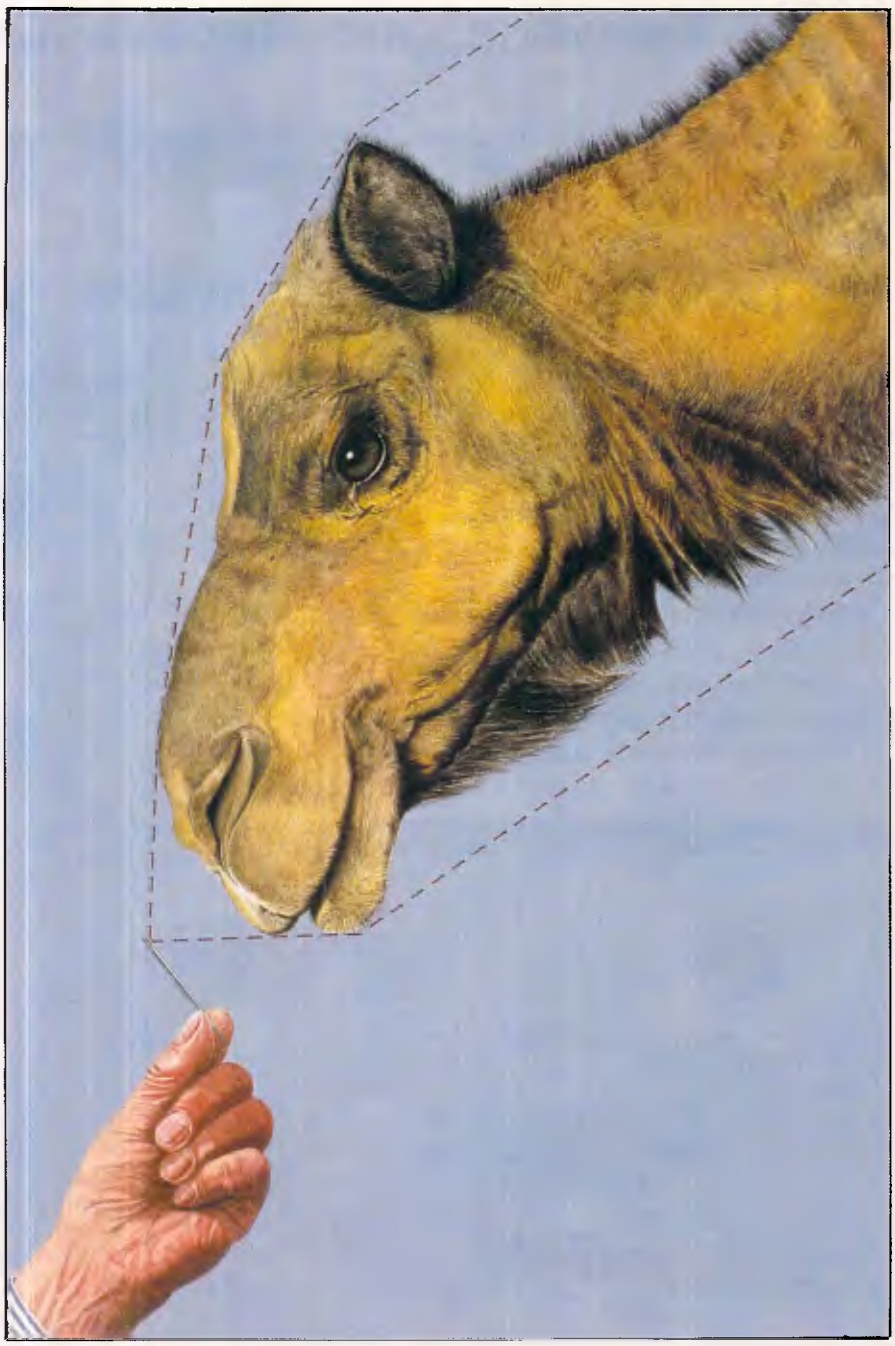
The missing link

Recursion is a useful but often overlooked part of programming which allows you to make choices through self-reference. Mike James sets the record straight.

This is part five of a six-part series on programming methods and the creation of programs. Parts one, two, three and four appeared in the July, August, October and November issues respectively, copies of which are available from Back Issues.



If the mention of 'recursion' makes you immediately switch off (either because you have read too many boring articles on recursion or because recursion is something that you have never understood or seen the need for), then don't — read on. This article isn't about extolling the virtues of recursion or about showing how different and magical recursion is. Instead, it concentrates on the way that recursion relates to programming methods, an idea that is rarely discussed; recursion is just a slightly modified form of the standard and familiar technique of iteration that occasionally proves to be extremely useful.

To write any program, you need a way of making choices and a way of repeating things. In most programming languages, choices are made by the use of something corresponding to the 'IF' statement, and repeating things generally involves an iterative loop either explicitly or implicitly. However, there is another way of repeating things that doesn't involve iteration, and this is recursion. Recursion achieves the repetition of a group of instructions by using self-reference. If a group of instructions can include the instruction 'do *this* list of instructions', then this self-reference will cause the list of instructions to be obeyed forever. This is a primitive form of recursion equivalent to an infinite loop. Self reference has long been a source of logical puzzles and paradoxes, and hence any use of it has to be treated with great care. For example:

'This sentence is false.'

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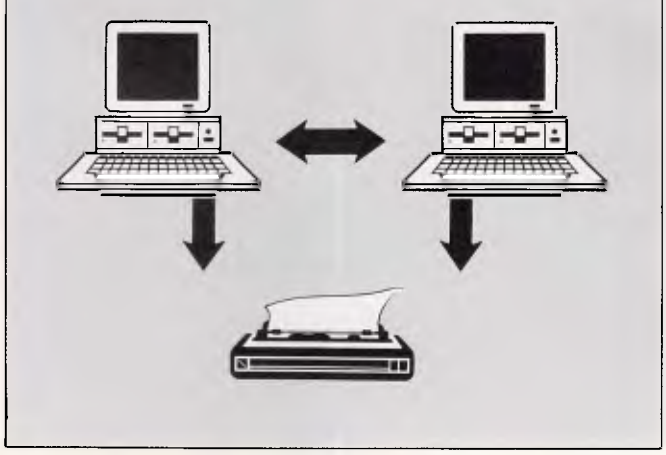

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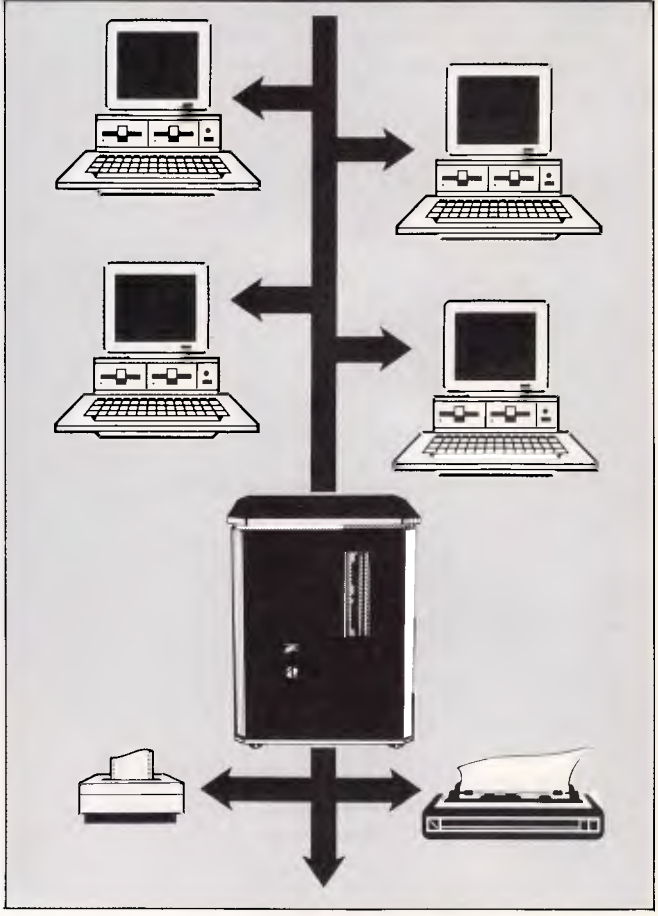

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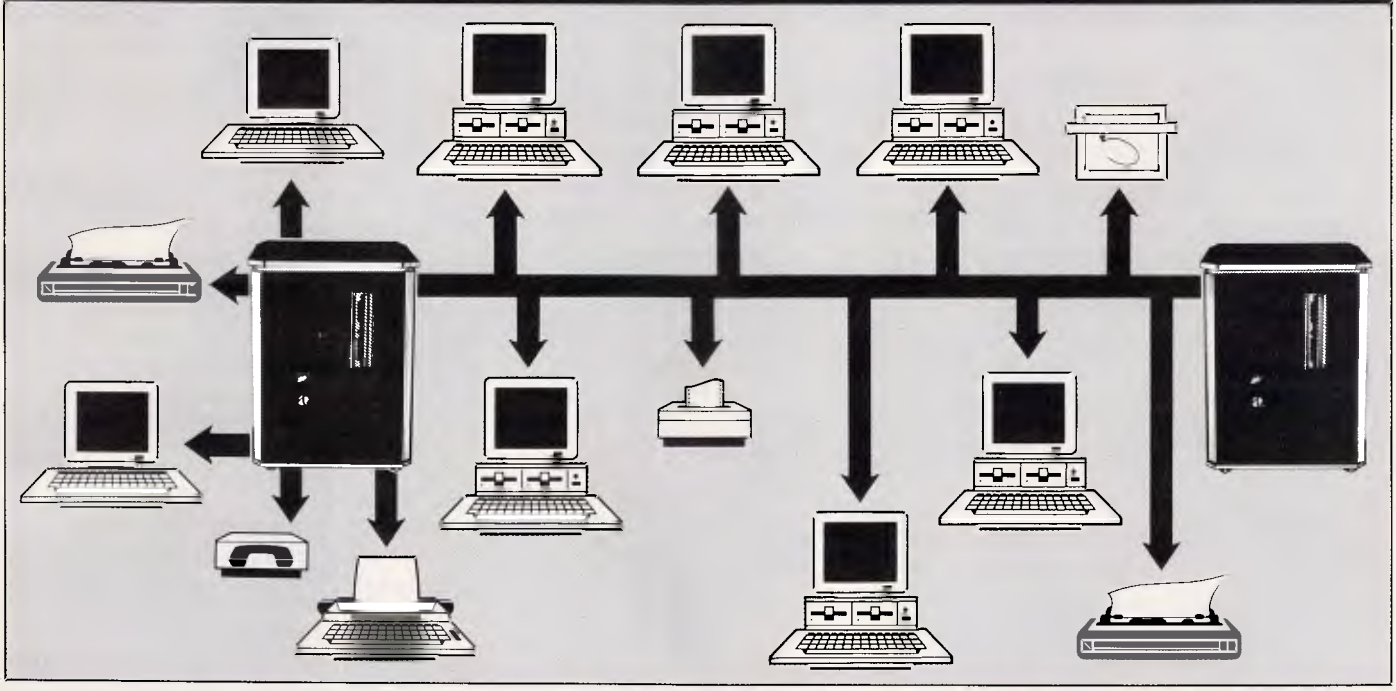

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is a paradox due to self reference that can keep you awake at nights!

Thus there are two ways of writing any program — using iteration and using recursion — and there are programmers who believe that only one of the ways is correct. This belief is held so strongly that the argument often verges on warfare. Most Basic programmers find recursion a strange and often difficult idea because most Basics don't explicitly allow recursion, and an unfamiliar idea is always difficult. There are applications that iteration and recursion suit equally well, but there are problems to which recursion is especially suited, and so it is worth trying to find out what exactly recursion provides that simple iteration does not. Notice that in programming, there is no suggestion that there is anything that can be done by recursion that cannot be done by iteration — it's just that sometimes the recursive solution is much simpler.

Practical recursion

In programming languages, recursion is implemented by allowing a subroutine or procedure to call itself. (In fact, just allowing a subroutine to call itself is minimal support for recursion. A computer language that is determined to be recursive has to do a little more than this — as we shall see later).

At first sight, the idea of a subroutine calling itself is mind-boggling and certainly doesn't seem to have anything to do with the ideals of clear, simple structure and natural modular hierarchy. Certainly in other walks of life, practical examples of recursion are thought of as curiosities. For example, when a TV camera is pointed at the monitor to which it is connected, we have an example of physical recursion in that the picture displayed must include itself. The result is, of course, an echo of images rather like that seen in two mirrors set facing each other.

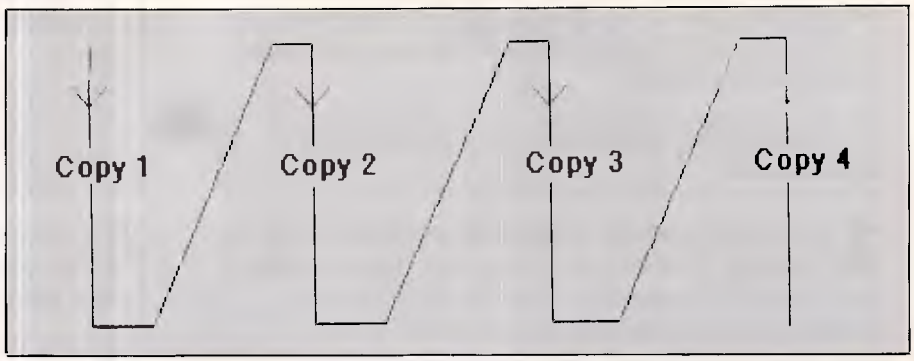


Fig 2 A spiral iteration

Because recursion is of practical value, it is important that programmers learn to be neither frightened nor seduced by it. For this very reason, the newer teaching languages such as Pascal and many dialects of Basic include recursion in the hope that early familiarity will make it as natural to the programmers of the future as iteration. Following this line of thought suggests that the best way to explain recursion is in combination with the familiar ideas of iteration.

The infinite repeat

As already described, the fundamental concept of iteration is the loop, or perhaps more accurately, the infinite loop. Consider the problem of printing the word 'HELLO' on the screen repeatedly. Most programmers would solve this problem in Basic using something like:

```
10 PRINT "HELLO"
20 GOTO 10
```

The same problem can be solved using recursion by defining a subroutine that prints HELLO and then calls itself to print another HELLO, and so on.

```
1000 REM HELLO SUBROUTINE
1010 PRINT "HELLO"
1020 GOSUB 1000
```

This second, infinite recursion version of the program has a lot of similarities with the infinite loop, but many programmers tend to panic at the sight of the GOSUB 1000 occurring in the middle of what they think of as the definition of HELLO. This can be made to look even more worrying by writing it in a dialect of Basic that allows names to be given to subroutines. For example, in BBC Basic the program would be:

```
1000 def procHELLO
1010 print "HELLO"
1020 procHELLO
1030 endproc
```

The GOSUB version of the program looks a lot more like a loop than the BBC version, but they are both the recursive equivalent of an infinite loop. The only difference is that the GOSUB command is superficially more like the direct transfer of control produced by the GOTO command. (Because it gives quite good support to recursion and is fairly widely used in Australian schools, the remainder of the examples will be written in BBC Basic). In principle, the way that you can stop any of these programs is by typing ESC, ^C (or pulling the plug out), but in practice you will find that there are physical limitations on the number of times a recursion can repeat. This is due to the real difference between iteration and recursion. When executing an iterative loop you are carrying out the *same* section of program over and over again, but each time through a recursion

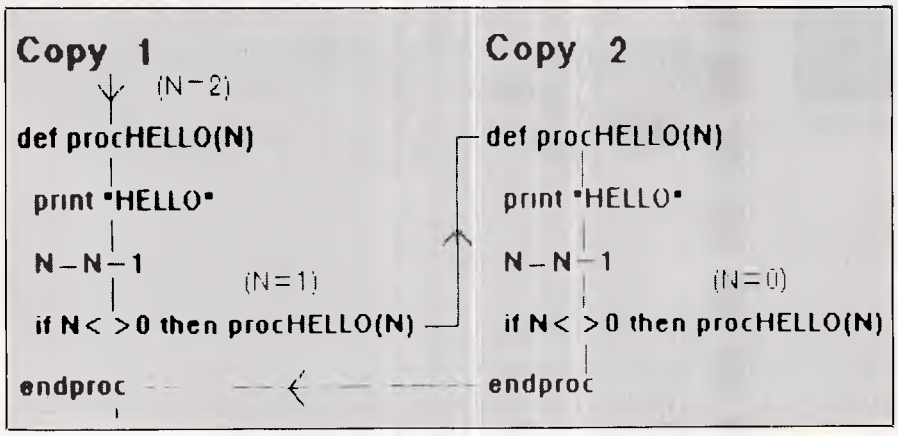
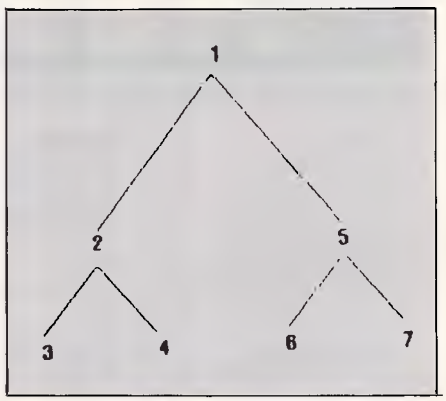


Fig 1 Path for the recursive HELLO for N equal to 2



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Inside information

Recursion is never explicitly needed because it is equivalent to using the familiar data structure — the Last In First Out Stack — in a particular way. You can convert a forward recursive procedure into a loop by replacing the recursive call by a GOTO at the start of the procedure. This, of course, handles the repetition inherent in recursion, but not the creation of new variables each time through the loop.

However, this is not important in forward recursion. Why? If the procedure includes backward recursion, then the creation of new variables is important and can be achieved by saving all the values of the variables in the loop on a stack before executing the GOTO, and pulling from the stack each time the procedure ends. That is:

```
recursive

label:
  actions 1
  if condition
    then do label
  actions 2
end

iterative

label:
  actions 1
  if conditions
    then stack variables:goto label
  unstack variables
  actions 2
end
```

you are carrying out a brand *new* copy of that section of the program. This 'new copy' idea will be explored in more detail later.

Conditional recursion

Infinite recursion is no more useful than the infinite loop, and so it isn't surprising that the next idea we have to examine is finding some way of limiting it. If we wanted to print the word HELLO on the screen 'n' times, then most programmers would find the iterative solution very easy.

```
1000 def procHELLO(N)
1010 rem start of loop
1020 print "HELLO"
1030 N=N-1
1040  if N <>0 then goto 1010
1050 rem end of loop
1060 endproc
```

where the variable N is being used as a loop counter which is decremented each time through the loop until it is zero. That is, the loop ends when n is zero. (This can, of course, be done more simply using a FOR loop, but this is nothing more than a shorthand form which covers up what is really going on in the loop). The equivalent recursive solution is:

```
1000 def procHELLO (N)
1010 print "HELLO"
1020 N=N-1
1030 if N <>0 then procHELLO(N)
1040 endproc
```

This recursive method of repeating something has a lot in common with the previous looping program. It has a counter, in the form of Variable N, which is decremented just before each repetition (line 1020). It also has an IF statement which controls when the repetition should come to an end. The difference can be seen more clearly if you try to follow the path through each program with your finger. In the case of the iterative solution you'll find that you really do go round in circles, but in the case of the recursive solution you have to write down a completely new copy of the procedure for each repeat. For example, the path for the recursive HELLO for N equal to 2 is shown in Fig 1.

Notice that at the point when the repetition ends, that is when N=0, the latest copy of procHELLO comes to an end and passes control back to the copy before it, and so on, all the way back to the very first copy. You can think of this as 'unwinding' the recursion. Thus, if going 'round in circles' is the natural 'shape' of iteration, then a spiral is the natural shape of iteration as the flow of control passes through each new copy of the procedure (see Fig 2).

Forward and backward recursion

The type of recursion described above is particularly simple because nothing extra happens during the unwinding of the recursion. That is, it is of the form:

```
Do something
if condition then do something
end
```

and when the condition is false, all the copies of the procedure just come to an end, one after the other, without doing anything. You can use this unwinding phase of a recursion to produce some interesting results, however. For example consider:

```
1000 def procBACK(N)
1010 N=N-1
1020 if N<>0 then procBACK(N)
1030 print N
1040 print "HELLO"
1050 end proc
```

Calling procBACK(10) will cause the machine to pause for a moment and then print out 0 HELLO, 1 HELLO, 2 HELLO, and so on, up to 9 HELLO. You should find this a little puzzling, as the value of N decreases by one each time a new copy of the procedure is called, and yet the values printed out increase! The reason for this is that the printing out is done during the unwinding phase of the recursion, and this takes you back through existing copies of the procedure in the reverse order to the one in which they were created, hence the increasing of N.

In general, recursions that involve doing something during the unwinding are more complicated and difficult to understand; and, of course, recursions that do something in the forward and reverse directions are even more complicated! Thus we can identify three distinct types of recursion as follows:

forward

```
label:
  actions 1
  if condition
    then do label
end
```

backwards

```
label:
  if condition
    then do label
  actions 2
end
```

forwards & backwards

```
label:
  actions 1
  if condition
    then do label
  actions 2
end
```

where actions 1 are carried out as each new version of the procedure comes into existence, and actions 2 are carried out as the recursion unwinds.

Local variables

One of the conditions that has to be satisfied for recursion to work is that each time you call a procedure, a completely new copy is brought into existence, and so far this 'new copy' principle has been implicitly assumed to work — but, of course, in Basic this is not the case! For example, consider the following version of the recursive HELLO program:

```
def procNOWORK
  print "HELLO"
  N=N-1
  if N<>0 then procNOWORK
  print N
endproc
```

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In principle, the program should print 'HELLO' during the forward part of the recursion and then, when N is zero, the unwinding of the recursion should print 0,1,2 . . .

However, if you try the program, you will find that it prints 'HELLO' the correct number of times but it then prints 0, 0, 0 . . . The reason for this is that in its present form, each new copy of the procedure inherits the original version of the variable N — that is, a new variable N is not created along with each new copy of the procedure. This means that when the recursion unwinds, there are no other copies of variable N to return to, and hence all the procedures print 0, the final value of N. When n is passed to each new version of the procedure as a parameter, a new copy of it is created, but ordinary variables are not recreated anew each time a procedure is called. To ensure that an ordinary variable *is* created anew when a procedure is called, it has to be a local variable — that is, a variable which belongs to that procedure and no other (see part three, October *APC*). In BBC and other dialects of Basic, a local variable is defined by being named in a local statement. For example, local A,B at the start of a procedure will cause it to bring new copies of the variables A and B into existence each time the procedure is used. To ensure that recursive procedures work properly, it's essential to name all the variables used, apart from those passed as parameters, as local.

What suits recursion?

Now that we can see recursion as nothing more than an alternative way of repeating something, the question that remains is: 'What good is it?' Some enthusiastic programmers see applications for recursion everywhere. Indeed, some computer languages such as Logo have been designed with recursion as the only way of achieving repetition, when the truth of the matter is that most types of repetition are better dealt with using iteration.

However, there are times when recursion is ideally suited to a problem. In particular there are some data structures for which a recursive definition seems natural, and this makes them good candidates for recursive processing. For example, a binary tree can be defined as a collection of nodes, each of which has a left binary sub-tree and a right binary sub-tree, or no sub-tree at all. A node with no sub-trees is called a 'terminal node'.

Of course, this is a recursive definition of a binary tree because it involves the idea of a binary sub-tree which is, of course, just a way of saying 'a smaller binary tree'! As this is a recursive definition, most of the algorithms that work with binary trees are naturally recursive. For example, a 'depth first search' of a binary tree that examines each terminal node from left to right can be written (in a cross between Basic and English) as:

```
def procSEARCH—TREE (T)
  if left_subtree (T)«Terminal node
    then          procSEARCH_TREE
    (left_subtree(T))
    else end
  if right_subtree(T)«Terminal node
    then          procSEARCH_TREE
    (right—subtree (T))
    else end
```

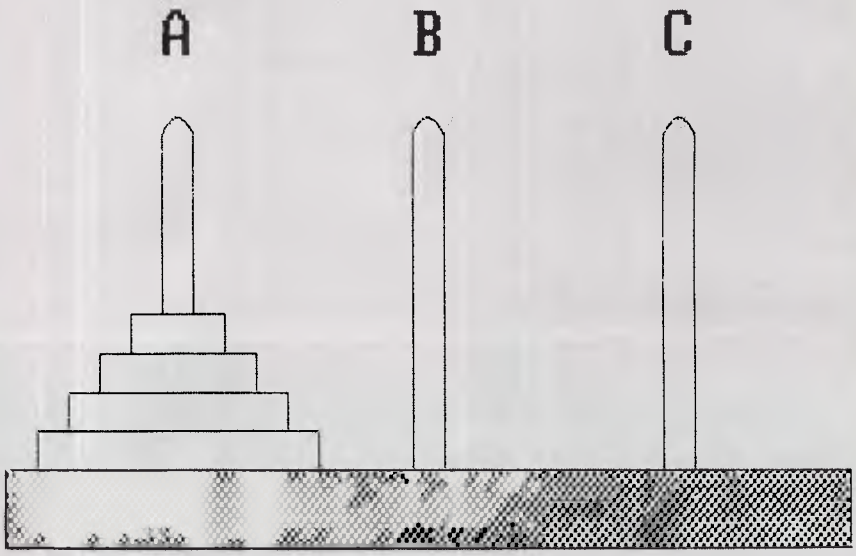
At this point, you might be once again convinced that recursion is difficult! However, if you look at the procedure carefully you will see that it is composed of two parts — the first 'if' statement is a forward recursion that searches down left-hand branches of the tree; and the

Creative challenge 5

This month's creative challenge is to find a simple non-recursive solution to the Towers of Hanoi problem. If you don't know the Towers of Hanoi problem it is:

Given three pegs and N disks of increasing size threaded onto the first peg to form a tower, move all the disks to another peg observing the restrictions — move only one disk at a time; and never place a larger disk on top of a smaller one.

This problem can be done iteratively without simply translating the usual recursive solution — see 'Inside information'.



The Towers of Hanoi problem

Answer to creative challenge 4

Creative challenge 4 was about how to stop a program. Given that subroutine 9000, deep down in the hierarchy, detects a condition that should stop the program, what should it do? There are two alternatives:
(1) It can use STOP or END to bring the program to a grinding halt.
(2) It can set a flag and return to the next level up the hierarchy.

The first solution has the advantage that it is easy to implement — it only requires one instruction — but it can be very difficult tp discover what conditions caused the program to stop. The second solution takes much more effort — each program above subroutine 9000 in the hierarchy has to test the flag that it returns to see if a halt condition has been detected — but if the whole program is constructed in this way, you can see just by examining the main program what caused it to stop. In many ways the correct solution is number 2, but most Basic programmers would use number 1 and hope no-one was looking!

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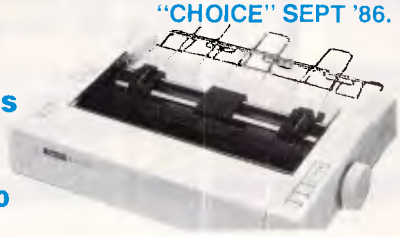

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second 'if' statement is a backward recursion that goes down a right-hand branch every time a left-hand branch is completely explored. Even with this reassurance, you might still be convinced that recursion is difficult. In English, the procedure is saying something like: 'Start at a node and search down through all the lefthand branches until you reach a terminal node, then back-up one and go down the righthand branch and search this node in the same way, and so on, until you have visited all the terminal nodes.' This produces the search pattern shown in Fig 3.

I must admit that even after all this time, I still get an uneasy feeling when looking at this sort of recursive procedure! But an equivalent non-recursive version of the procedure is very long and almost as difficult to describe (see *'BASIC Artificial Intelligence'* by Mike James, published by Butterworths). The key factor is that because the tree is defined recursively, it is easy to define recursive operations on it because left subtree(T) and right_subtree(T) are binary trees that have the same properties from the point of view of processing as the original tree T.

Variable loops — the real difference

If you look at any textbook on programming, you will find lots of examples of recursion much like the one described above (that is, factorials, Ackerman's function, Towers of Hanoi) but it is still difficult to see what makes recursion more convenient for some problems. What is it that recursion is so much better at?

The answer is surprisingly simple — variable numbers of loops. Our current programming languages make it easy to write loops in any given program. For example, you can nest two 'FOR' loops one inside the other; three, four, and so on, nested FOR loops are just as easy. But what about N FOR loops where N is a variable? A variable number of loops is quite a difficult thing to achieve, but with recursion it's easy! If you would like to try a problem that requires a variable number of loops, then write a program that will generate all the possible permutations of N things taken M at a time. For example, if both N and M are 3, then your program should output:

AAA, AAB, AAC
BAA, BAB, BAC
CAA, CAB, CAC

ABA, ABB, ABC
BBA, BBB, BBC
CBA, CBB, CBC

ACA, ACB, ACC
BCA, BCB, BCC
CCA, CCB, CCC

This can be generated using three nested loops:

```
For I=A TO C
 FOR J=A TO C
  FOR K=A TO C
   PRINT I; J; K
  NEXT K
 NEXT J
NEXT I
```

In general all the permutations of N objects can be generated using N nested loops, but of course this is difficult! However, the same problem can easily be tackled by recursion. To see this, all you have to notice is that if you have generated all the permutations of N things taken M-1 at a time, you can generate all the permutations taken M at a time by enumerating the additional item. For example, if you have all the permutations of three things taken two at a time, that is:

AA, AB, AC BA, BB, BC CA, CB, CC

then you can generate all the permutations of three things taken three at a time by writing A, then B, and then C in front of each of these. To write a neat recursive procedure based on this argument you first have to try it out and then clean up your mistake. It turns out to be simplest to write a procedure procPERM(P$,N,M) which will print the permutations of N objects taken M at a time, with P$ printed in front of each group. The resulting procedure is:

```
def procPERM(P,N,M)
  local I
  if M=0 then print P$:endproc
  for I=1 TO N
    procPERM (P$+STR$(I),N, M-1)
  next I
end proc
```

You can use this procedure to print the permutations of N objects taken M at a time by using procPERM("",N,M). If you examine this procedure, you should be able to see quite simply how it manages to create a variable number of loops. Each time procPERM is called, a brand new copy of the procedure comes into existence complete with a new copy of the FOR loop!

Creating a variable number of loops isn't recursion's only speciality, but it is the only one that is clearly difficult to replace with iteration. Most of the natural recursions that I have looked at reduce the need to create variable numbers of loops, even if it isn't obvious at first sight. For example, the depth-first binary tree search is equivalent to listing all the permutations of two things taken M at a time where M is the number of nodes, and so unlikely though this seems, it is a problem that requires a variable number of loops to solve iteratively!

The future

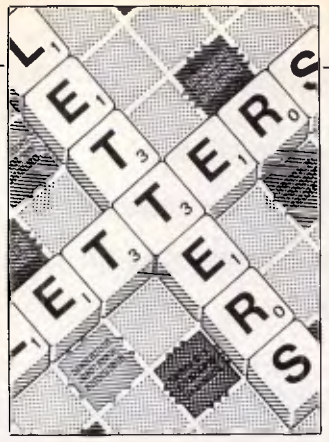
Perhaps one day a programming language will be invented that includes the facility for a variable number of loops in a natural iterative way, and then recursion will not be so attractive. Until then, we still have to try to make recursion fit in with the simpler elements of structured programming — necessary it may be, but it still seems too dense and potentially paradoxical a form of expression to be part of a good programming style.

This is not to say that I would join a witch hunt against recursion in the same way that a few misguided programmers damned the GOTO. (To avoid a flood of letters, I'd better add that it is the unstructured use of GOTO that is bad, not the GOTO itself!). All I can say is that in the same spirit, I hope that the fans of recursion will not try to stamp out iteration, and that it will find its way back into teaching languages such as Logo.

Finally, it is worth saying that the most important uses of recursion are to be found in the area of artificial intelligence, so perhaps it's not so much the future of recursion that we are discussing, but the future of computing!

Next month: Logic+functions = Prolog?

END



LETTERS

This is the chance to air your views — mail to 'Letters', Australian Personal Computer, 2nd floor, 215 Clarence Street, Sydney 2000. Please be as brief as possible and add 'not for publication' if your letter is to be kept private.

Give them enough rope ...

With reference to the article in 'Newsprint' ('Watch out — shady software about') *APC,* October, I believe the article reiterates exactly my observaton some time ago to your excellent magazine on this subject, when I stated something along the lines of: '... the cost of software has little to do with its cost of design/development, only the cost of the machine it is written for ...'

When will the avaricious software houses realise that they are slowly killing the goose that lays the golden egg? Can they not see that it may be better to sell, say, 5000 copies of 'BLAH+' at only (*only*) $1 profit each copy, than 1000 copies at a profit of $5 each copy? Admittedly the total profit is the same, but the most important point (which none of them seem to have yet grasped) is that 'Bloggs Soft Inc', or whatever, is now 'on the map'. When it comes to marketing its next masterpiece, there are now five times as many potential purchasers (assuming, of course, that 'BLAH+' was of some use).

As I said then, if the software is cheap enough, 99 per cent of computer users won't bother to 'pirate' programs; only those who would pirate it if it were free, for the sheer kick they get, would bother, and you can't stop them in any case!

I believe that the recent spate of 'deaths' in the software publishing industry are due, broadly speaking, to the gross overcharging that the industry indulges in. There will be more if the lesson isn't learnt.

H Leivers.

We all know that the actual physical cost of software is quite small, and it's also recognised that some software companies have been pricing their software according to what the market will bear.

But whether users buy software at $50 or $450, they will still expect a certain level of support from the dealer or publisher. And no-one can afford to support a product that carries a profit margin of $1.

How would you feel about paying extra for software support? Increasingly, software companies are charging extra for support as they are forced to drop their prices and margins. Are those consequences preferable?

Beauty's only skin deep

Although Guy Kewney can't suggest why anyone would want anything but an Amstrad PC1512 in place of a standard PC (Benchtest, *APC,* November), I can.

The Amstrad PC is certainly an attractive, keenly priced machine, but so are numerous clones which have already been competing near, or at the same price, with virtually the same functional specifications.

The reviews I have seen of the Amstrad PC, including Mr Kewney's, report factually enough on some of the machine's drawbacks, but their importance is lost in the effusive praise which leaves the reader with the impression that the machine is so nearly perfect that it has somehow managed to transcend all the pitfalls of microcomputer cloning in design, manufacture, packaging and distribution. It seems unlikely to me.

The drawbacks of the Amstrad PC1512 can be summarised as follows: 1) the keyboard and screen are poor; 2) the machine has not been used in anger long enough to know truly how compatible it is; and 3) its expandability is limited.

After all the abuse heaped on the IBM colour display, it hardly seems appropriate to downplay the fact that using the Amstrad display for any length of time could be more tiring on the eyes than the most berated screen in the industry.

Keyboards are more subjectively appreciated, but for my taste I would not like to type for long periods on the Amstrad keyboard. It has the same design faults as the Macintosh keyboard — the front is too high. It doesn't feel durable enough to withstand long periods of production word processing work.

From a non-technical user's point of view, the look of the display and the feel of the keyboard are the two most important ergonomic features of a machine. The Amstrad's faults are serious.

Already we are seeing evidence of compatibility problems with the Amstrad PC. I agree that EGA compatibility is not important at the low end of the market, but can you be so dismissive about choosing add-on cards which have a parallel port? Having to know anything about which add-on cards are compatible immediately ejects the user from the state of grace he supposedly enjoys in the Eden of Amstrad's packaging. Some unsuspecting users will lose money because of incompatibilities, no less so than with other compatibles or clones.

If you want to upgrade the RAM from 512k to 640k, you must do it when you buy the machine, or later bring it back to a dealer who can install the extra chips. For the price of the upgrade, do dealers really want to do this? They must charge more than the comparable upgrade on other clones where you can do it yourself for the price of the chips, which are now very cheap. Users will end up paying for the extra dealer service.

The acid test of compatibility in the corporate market will be in networking. Here it is very clear. The clones, and certainly the compatibles like the Amstrad, will sooner or later be left disconnected by IBM. Firstly, it is technically difficult to ensure full compatibility for networking. Secondly, connectivity is IBM's trump card in holding on to its corporate market — it seems certain that IBM will go to great lengths to

Go to page 149

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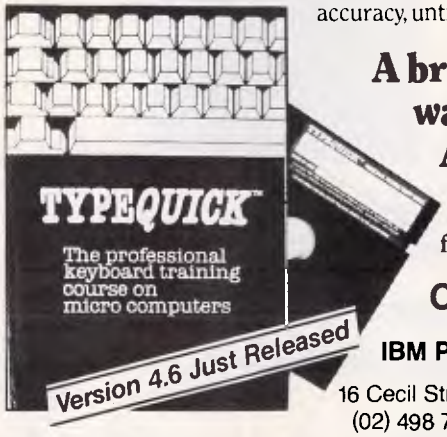

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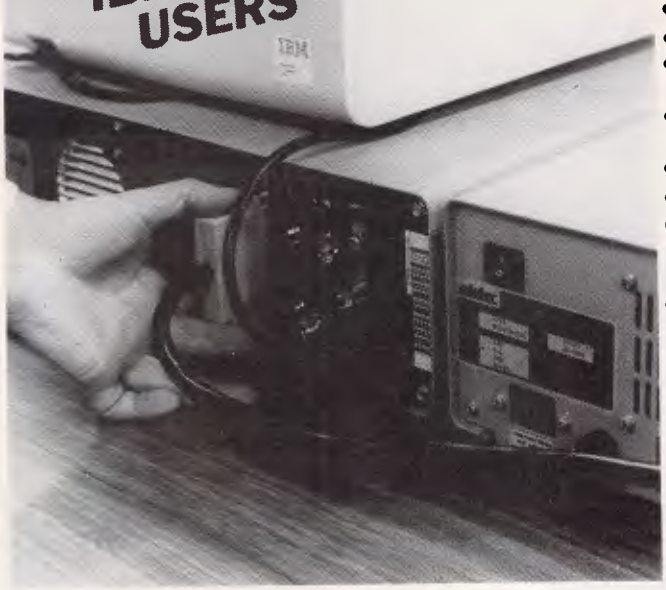

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Corporate Retriever

Most successful Australian software products have tended to be fairly specialised, as opposed to the likes of spreadsheets and integrated packages. In this screentest, Jacqui Futcher examines a PC-based Australian text retrieval package.

Corporate Retriever is one of a small number of text retrieval packages available for MS-DOS machines, including the IBM PC and compatibles. The system indexes existing files, and is able to rapidly locate specific information in response to user queries. Corporate Retriever is capable of reading files in ASCII format, or interfacing with a number of word processor systems: WordStar, MultiMate, Word Perfect, Word Craft, MS-Word and Word Wand. Figure 1 shows the type of information that lends itself to text retrieval applications.

In general, text retrieval systems fall into one of two main categories, which then dictates the overall form of the package. Keyword-based systems rely on the user to nominate all possible words of interest, and these are all that are indexed from text of documents. Full text systems index all text words, with the exception of user designated common words.

Many word processing systems incorporate a rudimentary keyword indexing facility, allowing the operator to attach keywords to documents for later recall. These systems result in relatively small index files, but are limited in their retrieval capability. As areas of specific interest shift, the initial keyword designations may not cater for the expanded range of topics. A recommendation to purchase a particular machine, indexed under EXPENDITURE/ASSET/PC, would not come to light in an investigation of shady dealings between the staff member, Mr Badman, and the suppliers, Los Cheapo PCs.

Full text systems result in larger index files, but provide superior retrieval capability since virtually all information is indexed. The Corporate Retriever index of 40 360k diskettes of information would be about four to five megabytes in total.

The main points of distinction between various full text retrieval packages lies in the flexibility of the query language, the speed of indexing and whether structured text is supported. Other criteria include development facilities for specific applications, thesaurus integration, formatted fields and output report generation. Let's look at these points in some detail.

Installation and user interface

The software is distributed on three floppy diskettes, with a 180 page manual in a binder. The manual is also distributed on the diskette, ready indexed with additional demonstration files. The files can be copied onto the hard disk, and everything is ready to use. There is no copy protection, but the demonstration version will only allow 50 to 60 pages to be indexed. To remove this limit, the software must be registered via a telephone call to QCOM in Brisbane. This registered copy is also copyable, but contains the 'business name' typed in at registration time. This seems a fair compromise between paranoia and the open market.

'Corporate Retriever confesses without shame that the acutal indexing of documents is time intensive',

The manual is divided into two sections, allowing the user to immediately perform searches and load sample information without any detailed reading. The second section provides reference material on all the features of Corporate Retriever. The size of the manual and apparent simplicity of use belie the true power of the product.

All communication with the internals of the machine is through DOS calls, which means that the system will run on such machines as the DEC Rainbow and HP 150. Some screen addressing configuration may be required if ANSI.SYS is not used. If in doubt, ask to see a demonstration on your model machine.

The different functions such as query, indexing and database reorganization are supplied as separate executables, bound together by a front end menu. The user interface will be a mild disappointment for those expecting 'point and press' command selection — no WIMPS here. The product is command driven, although the more frequently used commands may be abbreviated to single characters. In under an hour, I had loaded 300k of Pascal source to the supplied demonstration database, which consisted mainly of legal abstracts, and had mastered the major query and retrieval commands.

Query and retrieval

The Enquire program allows you to construct lists of files satisfying queries, and browse through these files. All queries are resolved through the indexes without scanning any test, which not only gives fast results, but also means that information maintained on floppy disks can be located without loading and switching diskettes until the information is to be displayed.

Once again, two different strategies may be used by designers in searching. One approach is to consider only the current search, and narrow down progressively from a large number of possible documents to a smaller number containing more relevant information. Along the way, searches may be rolled back one or more levels. The other approach is to maintain all searches and results, allowing the combination of previous searches to form new specific result lists. Corporate Retriever leans towards the latter approach, but does also allow a form of subquery.

Simple queries may be used to locate words and phrases. Wild card operators

(?), repetition (*), alternate spellings (!) and 'sounds like' facilities are all supported. To locate all files containing the phrase 'personal computer' or 'personal computers' or 'personal computing', the query term

PERSONAL COMPUT?*

would result in at least those possiblities.

The 'sounds like' facility is invaluable both for the location of proper nouns such as surnames, and to chronic bad spellers. The process used is based loosely on the Russell Soundex algorithm and produces some impressive results. It is satisfying to learn that DEC, TACKS, TAKES and DISCS all sound like TAX as far as the Corporate Retriever index is concerned.

More complex queries can be constructed by combining simple terms with boolean operators and context limits. The logical operators AND (AND or ∧), OR (OR or ,) and NOT (EXCEPT or -) are provided, and parentheses may be used to alter the left to right evaluation. For example, the query

(CATS OR DOGS) EXCEPT (CATS AND DOGS)

will find all files containing either the word CATS, or the word DOGS, but not those containing both. The 'nearby' operator is used to locate words in context. To use another example:

INCOME /6/ TAX

locates all files in which the word TAX appears within six words of INCOME. Try that on a keyword-based system!

Corporate Retriever also supports inherent structure in the files to be indexed. For files containing such things as manuscripts or source code, this may be of little use. However, files containing personnel resumes, memos, library catalogues, school reports and suchlike tend to consist of descriptive text after regular section names. Queries may be limited to nominated sections, resulting in very specific search criteria. To locate all memos originating from our nefarious Mr Badman, a simple query

BADMAN WITHIN FROM

would be sufficient. This initial list of possibly hundreds of files can be narrowed down using a general query on the suppliers, Los Cheapo, and combining the two searches to provide a list of all documents originated by Badman that contained the name of the supplier. Yes, Corporate Retriever allows for the recall of previous queries, and the combination of results without retyping or reprocessing the searches. Obviously it is possible to live without this facility, as some people survive without autodial modems, but why not take advantage?

Fixed fields, either text or numeric, may also be attached to documents at indexing time without editing the original documents to be catalogued. Searching on these fields allows numeric subranges to be specified, and righthand truncation of text. For the keyword indexing purists, here is the opportunity to superimpose a manual 'filing' system on the top of the automated text indexing system.

Having located documents of interest, Corporate Retriever provides a BROWSE command to inspect the contents, without leaving the product to fire up whatever editor may have been used to create the original documents. BROWSE will display one or more documents from the list of those currently located, and allows stepping through in pages or by occurrence of the terms used in the search. The terms appear highlighted in the text, and the file name and title are shown at the top of the screen. This leaves the user in no doubt as to which document is being displayed at any time. It would be useful if the BROWSE facility supported structure in the documents, so that display could be confined to specific sections of the text, but this is not provided.

One perceived problem with full text retrieval systems is the sheer wealth and diversity of indexed vocabulary that arises from the various documents indexed. One possible comment is that any well written work should contain all germane terms and references. Bearing in mind that we do not live in an ideal world, Corporate Retriever has included a thesaurus facility. This may be used to expand searches (rather than limit indexing) using synonyms and broader and narrower terms. A thesaurus entry is indexed and retrieved as a document. Terms contained within the entry may then be selected to form a new search. This search may retrieve further thesaurus entries as well as relevant documents.

There are other ways of implementing a thesaurus facility, and this is neither the best nor worst that I have seen. Maintaining a thesaurus as a series of indexed documents means that the entries can be loaded into other databases dealing with the same type of information, and the user need remember no new commands to make use of the facility. Corporate Retriever steps through each line of the retrieved and selected thesaurus, prompting whether each term should be used as a query. I favour the approach that views synonyms, broader terms and narrower terms as sets of terms that may be included in a search, and automatic

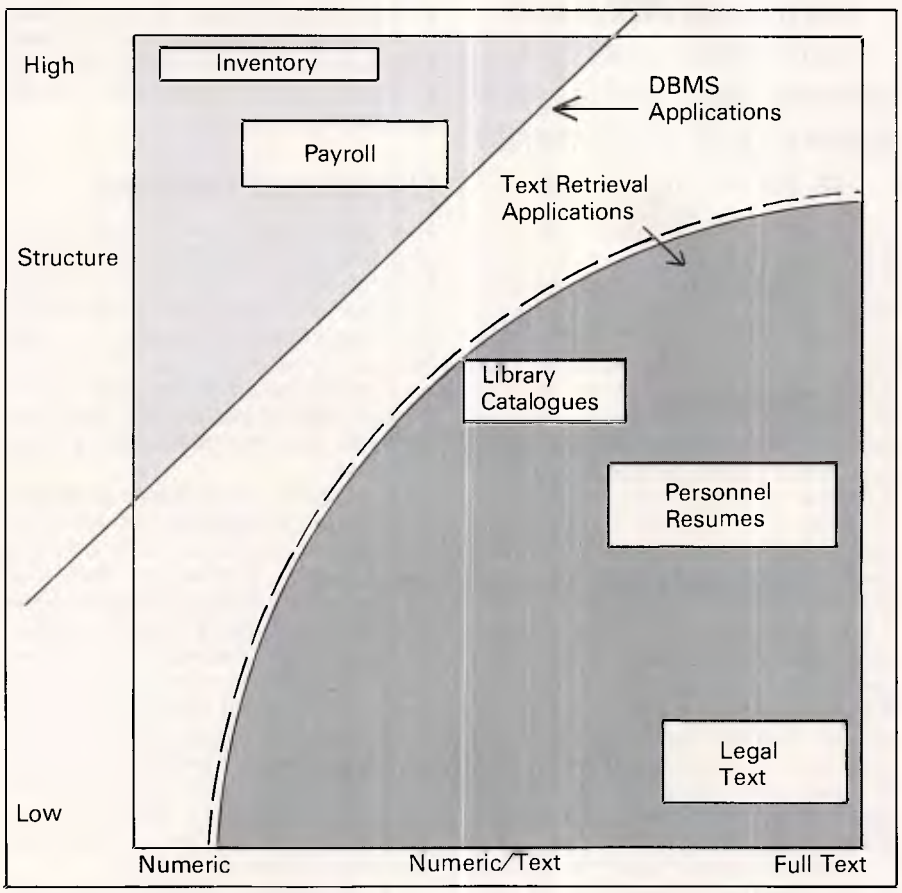

Figure 1 — Information categories

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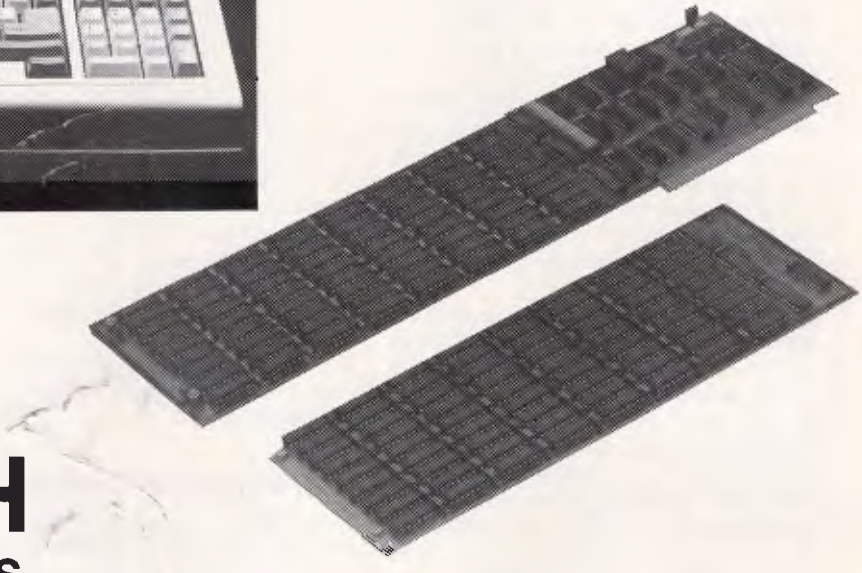

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expansion to cover nominated sets in searches that wish to use the thesaurus. The format of the Corporate Retriever thesaurus, with each entry viewed as a separate entity precludes this level of automation.

The retrieval program includes other features as icing on an already attractive cake: sessions, or parts of sessions, may be logged to a disk file or printer; online help is available, for all eighteen commands; output to the screen may be turned off, if for example a lot of information is being copied to the printer; a limited set of options may be used for common word handling and the display of information; commands may be read from an ASCII file rather than entered through the keyboard; and two very useful summary commands are available. The last two features bear further investigation.

The BROWSE command displays documents as a whole, without recourse to the original editor or word processor that was used to create the information. In many circumstances, a summary of the relevant information in a document is preferable to wading through pages of text, despite the capability of jumping rapidly through the pages containing the search term(s). The CONCORD command creates a list of all documents satisfying a search, and each line that contains the relevant term. The SAVE command copies the list of file names of documents satisfying a search to a disk file. Both these commands were of great use in one application that I planned for Corporate Retriever — indexing massive amounts of program source code. As well as specific application code I have libraries which include files containing useful procedures used in a number of applications. If I think of a change to one of my procedures, I can search for the name in all my code, and see immediately which areas may be affected, using the CONCORD command. The list of effected files can be written out using SAVE, and off I go. Far less painful than waiting for the compiler to point out my oversights.

The other feature, reading commands from a disk file, uses the GET command. Unfortunately this did not live up to my expectations, which were high. I saw this as the start of a whole application development tool, whereby library loan systems could be integrated with the catalogue, program maintenance performed as relevant files were located, out of date memos archived off to some mass storage system, external databases dialled up when internally held information was not sufficient or a complete rewrite of the user interface with menu selection or function key recognition. I mistakenly believed that Corporate Retriever could be used as an umbrella over an entire text information system. But this is not so because there is:

- No user input ability
- No decision control
- No calls to DOS.

Since users may not substitute their own information for parameters held in the GET file, commands that are entered must be complete. For example, generalized searches for memos by a user designated author may not be set up. Without decision control, a FIND command that locates no information followed by a BROWSE command will result in a nonsense situation (although not a system failure). No calls to DOS means that it is not possible to start up another process, be it another package or a specific application program. This has an attractive side benefit though. Corporate Retriever uses any system memory above that used by the package as a cache for I/O.

'The user interface suffers because of the portability aims, but a little command typing is good for the soul'.

The limitations of the GET facility illustrate the philosophy that Corporate Retriever is a user tool, designed to be simple to use and as an adjunct to other processes performed on the machine, rather than integrated with the text creation and maintenance side of things. Once this is accepted, GET may be seen as a useful feature to eliminate the typing of long and/or repetitive commands.

In summary, the retrieval capabilities of Corporate Retriever are very good, with a wide range of query facilities, an adequate thesaurus capability and a very well integrated display function which reads word processing documents directly. The ability to revert to earlier searches and combine search results without reprocessing is much appreciated, and the CONCORD command wins my vote as the 'best surprise on the side'.

Database creation

In one sense, a database is never actually created in Corporate Retriever. The textual information to be held resides on disk files, having been entered either with an editor or word processing package. Corporate Retriever simply indexes this information, and locates relevant files when asked. The collection of disk files and associated index files for an application could be viewed as a database, in a slightly catholic sense of the word. Unlike fixed format database systems, such as dBase, Dataflex ***et al,*** the main intellectual effort in defining the form of a database lies in describing any special considerations in the vocabulary, rather than specifying the name, type and length of fields within a record.

Since it is quite reasonable that one copy of Corporate Retriever will be used to index more than one type of information on a machine, separate index files may be maintained for each type of information. The programs may be found via a path statement, and the index files in the current directory are used as the basis of a search. The index files hold information on the filenames that have been catalogued, the word references within those files, the text sections which have been established for the database, the word processing interface to use and the special vocabulary considerations. Either one common word file can be held for all databases, or specific common words may be set up for an application.

By default, all words consisting of the characters A - Z, a - z, 0 - 9 are included in the index, other than common words. Corporate Retriever allows extensions to this set. Special characters, such as '-' or '&' may be included in the normal character indexing range. In addition to this facility Corporate Retriever allows for context sensitive characters. This means that it is possible to say that a particular character is important only at the start of a word, or in the middle of a number. This can help overcome some of the more common traps for young players. In a number of text retrieval systems, the word 'flat-mate' would either be indexed as one word, nine characters with a hyphen, or as two separate four character words. With Corporate Retriever, if the hyphen is declared to be ignored in the middle of the word, this would be indexed as an eight character single word, the same as 'flatmate'. There are limitations, in that only one specific context may be declared for each of the special characters to be handled in this way. This means that you have to decide, for example, whether it is more important to deal with the hyphen in the middle of a word or at the beginning of a number.

Text sections may also be more structured than simply listing the names of sections to be found in documents. Sections may be assigned to levels, from one onwards, with two reserved level numbers. Using the example of a personnel resume indexing system, containing personal details, technical overview and work history, table 1 shows one way in

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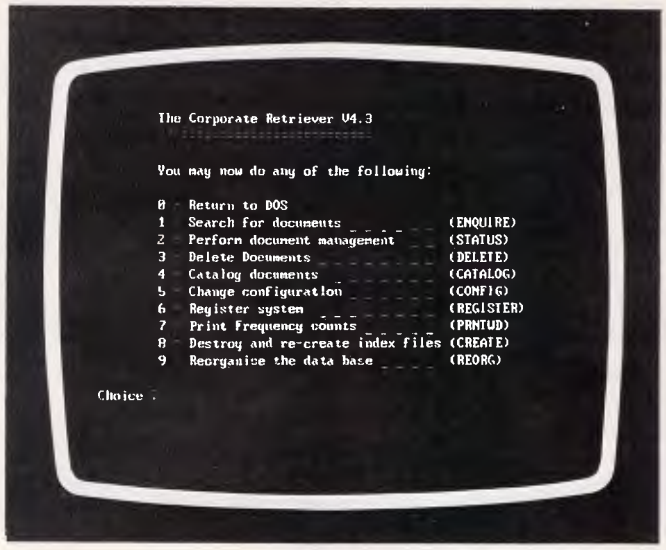

Fig 2 The Corporate Retrieve main menu

Fig 3 The STATUS program

which the sections could be declared. The two reserved levels are 0 and -1. Level -1 is used to divide one physical file into a number of logical documents. This could be used for indexing small abstracted information, such as a library catalogue. The week's acquisitions could be entered into one document and catalogued by the system as a number of logical entries. Level 0 means end of indexing. This is a useful feature for cutting down the size of an index file. Information that is useful to display, but not necessary to index, such as footnotes, can be left in a document, but not be indexed.

Fixed fields may also be defined for a database, giving the name and whether they are text or integer. These fixed fields are associated with each document, and may be either entered at indexing time or embedded in the text of the document. One oversight is the lack of support for dates. In many applications, the ability to search on ranges of dates would be extremely useful. Unless dates are entered as a fixed field of 8 or 6 integers in year-month-day order (most primitive) there is really no hope.

The manual does not give specific details about the actual indexing system used. A little knowledge of standard text retrieval methods, and some digging to discover the DOS calls being used in query and display, uncovered some interesting information. Associated with each database is a set of five files, all with the extension TRS.

CONFIGS contains information on the word processing interface to be used, special and context sensitive characters, path names for the other index files, terminal specific characters for systems that do not use ANSI.SYS, and text section names. This is the heart of the index, pointing at the other files.

COMMON holds the list of common words (a maximum of 101). This is a plain ASCII file, maintained with a text editor. INDEX appears to hold the vocabulary of the catalogued files, but no specific references. REFS holds the actual references for each word in the vocabulary. Each reference has to identify the file in which the word appears, the section in which it appears, and the actual location by word count, of the word. Rather than use precious bytes holding text sections and file names in full character form, these are encoded into numbers. DOCS turns the file numbers back into names, and the section name translation table is held in CONFIG. This is the key to any system limits in terms of size. The maximum number of words in a file, section names in the database and files which may be indexed will be directly related to the maximum number of bits assigned for each of the related numbers.

Corporate Retriever allocates 10 bits for the encoding of section names across all levels. If only one level is used, then the maximum number of sections that may be defined is $(2^{10} - 1)$ or 1023. As more levels are introduced, the 10 bits are split across each level. In the personnel example, there is one section at level 0, three at level 1 and six at level 2. This will require one bit for level 0, two for level 1 and three for level 2, a total of six bits out of the ten. To allow for later expansion of the design, dummy section names could be included to pad out the number of bits to be used, and later renamed accordingly. Otherwise, the entire database has to be reindexed.

File names are not encoded, rather pointers are used into the DOCS file. The maximum number of files is therefore limited only by the DOS 30Mb file limitation on the size of the DOCS file. The maximum number of words in a document is 32,767. If a file exceeds this limit, it can always be split into logical documents.

Indexing

Corporate Retriever confesses without shame that the actual indexing of documents is time intensive, and best run overnight when including large numbers of files.

Interactive use of the indexing program, CATALOG, is very simple. The program prompts you for the name of the file to include, which may include a drive and path specification, and the values of any fixed fields associated with the document. Processing ends when a blank filename is entered. A number of commands have been established for unattended processing, which is much safer that setting up a file with expected input to questions and using DOS redirection facilities.

These commands allow the setting of a default directory; specifying a word processing interface; establishing a value for a fixed field; reading a list of filenames to be processed and indicating that a file is a thesaurus entry. One of the Corporate Retriever utility programs, STATUS, allows automatic generation of a command file to use for unattended operation. This interfaces neatly with the CATALOG program.

The speed with which indexing is performed is affected by a number of factors. The processor on the machine is an obvious factor. The amount of memory also comes into play, since any memory above that required by the program is used as an I/O cache. A sensible selection of common words will cut down the amount of indexing for a given docu-

Fig 4 Locating assistance

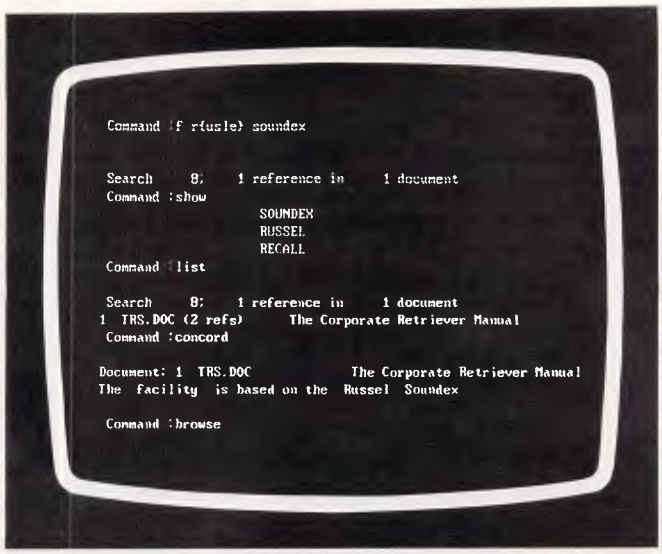

Fig 5 Using the 'sound like' facility

ment, and to a lesser extent, the size of the existing reference file will effect speed.

Corporate Retriever claims to be able to index 250k of data per hour on a standard IBM PC with 320k RAM.

The machine on which the following tests were run had 640k RAM, an 80286 processor running at 10MHz with no wait states. The hard disk had a 28 Msec access time. (A standard PC/AT has a 6MHz processor and 37 Msec disk access time. A PC has a 4.77MHz processor and 70 Msec disk access time).

The tests were run to investigate two areas: the rate at which the index files grow as data is loaded, and a performance comparison between loading an empty database, and one in which the index files are larger than the I/O cache. Refer to table 2.

This indicates a linear increase in all three index files, keeping a 1:1 ratio in total size with the data indexed. This is consistent with other text retrieval systems at the 1Mb data mark.

The increase in INDEX file size will slow as more data is loaded, since the indexed vocabulary increases less, as many words will already exist in the file. The DOCS file will continue to grow linearly, holding document names and fixed field values for each file indexed. The largest file is REFS, which gave no indication of levelling out at the 1Mb mark. This would be the file to watch in a 10Mb benchmark.

In terms of performance, five minutes execution indexed 300k of data with better than 95% cache hits on an empty database.

After indexing 1Mb of data, five minutes execution indexed 30k of data with 40% cache hits. This illustrates a severe degradation in performance, allowing for the speed of the test machine. Naturally, buffers can be increased in the CONFIG.SYS. file, and sensible additions to the common file would improve this figure.

It is worth noting that retrieval performance did not degrade in the same manner.

Naturally queries took longer to process as the index files increased, but a search on a term occurring 1500 times and one occurring 250 times was processed in under one second.

Utility programs

Corporate Retriever comes complete with a set of utility programs to perform basic maintenance on the index databases, and generally make life easier. The STATUS utility, mentioned above, is a perfect example. This allows you to investigate directories for new, updated and deleted files. Command files may be generated for the CATALOG and DELETE programs automatically, which is as welcome and useful as screen generation in database products.

The DELETE program is used to remove references from the Corporate Retriever index files, rather than in the DOS sense of the word. Note that this has a repercussion on large files containing many logical documents. If one document is changed, it appears that all information should be removed and then reindexed. PRNTWRD lists frequency counts for indexed words occurring greater than a specified number of times.

Text section	Level	Contents
Details	1	Name, address, age etc
Overview	1	Major skills
Hardware	2	Machines used
Opsys	2	Operating systems
Languages	2	Programming languages, packages etc.
Applications	2	Application areas, eg Banking
Experience	1	Detailed work history
Employer	2	Name and period of employment
Description	2	Work undertaken
References	0	Not useful to index

Table 1 — Sections for a personnel resume

Number of Files	Words Indexed	kbyte Increase in the files: INDEX	REFS	DOCS	Approx. Execution
14	27,004	46	115	4	10
10	23,452	39	100	4	10
74	51,148	130	267	11	50

Table 2: Details of indexing performance tests

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SCREENTEST

The output may be copied to a disk file or printer as well as the screen. This is useful to determine candidate common words.

CREATE wins the prize for misnomer. CREATE wipes out any existing index files and reinitialises them to start a new database. Maybe it should be called SCRATCH or INIT—CREATE sounds so innocuous. REORG is used to clean up index files which have become internally disorganised after much deletion and reindexing. It is not strictly necessary, but can improve performance.

A password driven security system is provided. Three passwords are supported, all set to 'Ethelred' as delivered from QCOM. Of course, it would probably be better to protect the original data, rather than the indexes, but at least the option is available.

Conclusion

Corporate Retriever is one of the better text retrieval products available on the MS-DOS machine range. Although it is not closely integrated with any specific machine features, relying on DOS calls for operating system assistance, the level of integration with the supported word processing packages more than makes up for this. Indexing and retrieval are acceptable in speed and consistent with other packages on the market; and the query language is both simple and flexible. The utility programs may not provide every possible piece of information about the state of a database, but cover all the important aspects and are easy to use. The user interface suffers because of the portability aims, but a little command typing is good for the soul. The manual is well laid out and a pleasure to read.

The standard copy of Corporate Retriever retails for $2,500, which definitely places it in the corporate and professional researcher market. A cut down version is available for the struggling authors in their garrets at $990. This excludes the thesaurus, soundex and fixed field facilities and the STATUS program. Telephone support is provided by QCOM and local representatives at 15% of the purchase price per annum.

END

TAS + has no equal

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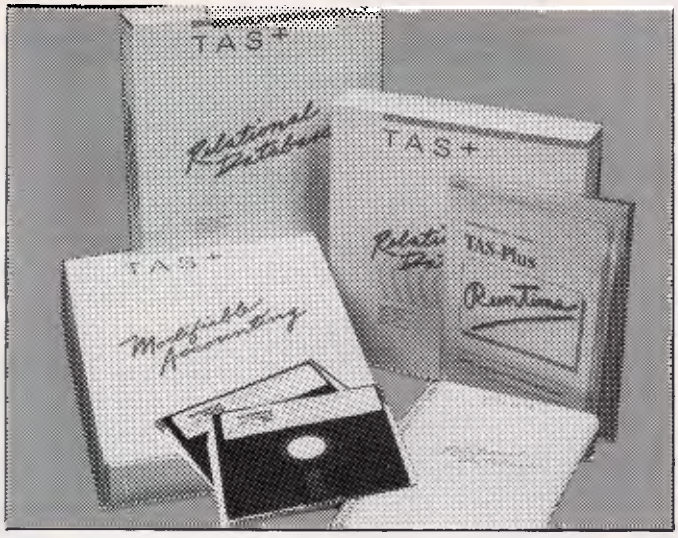

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- Save up to 65,000 records in one file (limited by disk space and operating system).
- Find any record in a file in less than 3 seconds.
- Number of fields per record is limited only by operating system.
- Up to 254 characters per file.
- Up to 16 files open at same time.
- Up to 16 key fields per field.
- Up to 10,254 characters per record.
- Field type may be alpha, numeric, date or time.
- TAS – Plus Data Dictionary maintains all data file structures in one handy location.
- Dates use only 4 characters of storage.
- Numeric fields stored in BCD format (a 10 digit number uses only 5 characters of storage).
- Numbers can be up to 20 digits long and have up to 8 significant digits to right of decimal place.
- Print reports to screen, printer or disk.
- TAS – Plus program can exchange standard ASCII data with other programs. Convert Dbase III data files to TAS – Plus and vice versa.

Procedural Language

- Up to 4,500 command lines per program.
- Up to 255 named fields per program.
- Key files not counted as open file. All data file keys stored in one index file (opened automatically with data file).
- Powerful B-TREE file structure allows you to search on any one of 16 key fields per record without sorting.
- Up to 16 screen/report formats per program.
- Allows numeric and string arrays of up to 255 elements each.
- Gosubs may be nested 10 deep.
- Up to 10 nested parentheses per expression.
- Structures may be nested 10 deep.
- True recursion capabilities (subroutine can call itself).
- If command allows true if/then/else programming.
- If comparison types include less than, less than or equal to, equals, equal or greater than, greater than, and not equal to.
- Multiple company capabilities allow up to 1,369 different sets of data files to be accessed by the same programs.
- TAS – Plus has 86 commands (plus several options on many commands).
- Supports date and time arithmetic.
- Context sensitive help messages are easily added to applications.
- Find command can search for exact match, partial match, next record, previous record, beginning of file, end of file or related field between two files.

Compiler

- TAS – Plus compiler converts TAS applications into fast running pseudocode (executable by TAS – Plus run-time).
- Automatically checks program for syntax errors and command usage problems as it is compiled. Helps catch "bugs" before they become problems.
- Automatically checks to make sure files used exist in data dictionary or are defined in application.
- Compiled run-time programs are automatically compacted so they take up less disk space.
- TAS – Plus allows you to create run-time versions of your applications that are separate from the source code (perfect for program developers who intend on selling finished products).

Screen Painter

- Create screens that will look identical to your applications.
- Easily add color or graphic characters to your screen by making menu choices.
- Automatically create programs by "painting" the screen and allowing TAS – Plus to write the program.

Source Code Editor

- Displays all TAS – Plus commands in plain English.
- No need to memorize difficult syntax. The Editor displays all options and makes sure you make all required entries.

Report Writer

- Create and run reports quickly and easily.
- Columns can be totalled.
- Up to 10 different fields may be used as selection criteria in each report.
- Reports may be run over again and again.
- Report programs can be modified using the source code editor.

Other Utilities

- Browse utility lets you display 10 records at once, choosing which fields and in which order to display them.
- Maintain database lets you add change or delete records in a file.
- Create database adds a new database definition to the TAS – Plus dictionary and allows immediate entry of data.
- All utilities are menu driven and require no programming knowledge.

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Developer's Version

For those who need even more power, there's the Developer's Version of TAS – Plus Relational Database. It offers everything that the standard package includes, plus a Programmer's Toolkit. It's the perfect addition for those persons developing sophisticated applications.

The Programmer's Toolbox allows the user to access features not normally available on a database/language. Primary among these are the ability to access additional blocks of program memory (up to 96K), to access files using variable file numbers (even if file names are unknown), and to directly control the memory stack (pop the stack). You can also have up to 17 million records per file and 32 Indexes per record.

Developer's Version also includes a Trace Utility that lets you place break points in your source code (for easier debugging). The Trace Utility includes: set break points, examine/change field value, and single step execution and Enter other character to continue normal operations.

For those who want to use a standard ASCII editor, the Developer's Version provides a complete cross listing of TAS – Plus commands plus a straight forward method of manually writing code. This includes a way of incorporating both screens and reports into the actual code.

Developer's Version includes these additional commands:

binary character
close variable file
display memory
file name search
fill memory
find rec var file
memory ptr update
memory space update
move string
open variable file
pop stack
print screen
ready find field
trace enable

TAS – Plus Commands

The TAS-Plus language commands are listed below in alphabetical order:

bell
clear array
clear buffer
clear line
clear screen
close non-tas file
close tas file
company code
compile program
cursor on/off
date
define field
delete record
delete file
display array
else
enter
equals
equals active records
equals day
equals location
equals month
equals portion of
equals record num
equals size
equals total records
fill field
find record
for/next
get character
get field from buffer
gosub
goto
if
if carriage return
if duplicate
if rec not found
initialize file
justify field
line label
menu
mount
on value
open non-tas file
open tas file
print chr$
print black lines
print box
print message
print on
print outside window
print report line
print set
print vertical tab
put field in buffer
put portion of
read non-tas rec
redisplay screen
reenter field
remark
rename file
return
reindex
file
run dos command
run non-tas program
run tas program
save record
save screen
screen lock/unlock
scroll
set color
set file active
set video highlight
set video normal
set video reverse
structure start
structure stop
time
top of form
trap
trim field
upcase field
while
window
write non-tas rec

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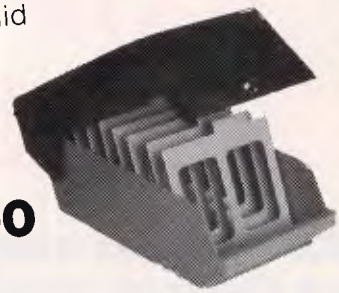

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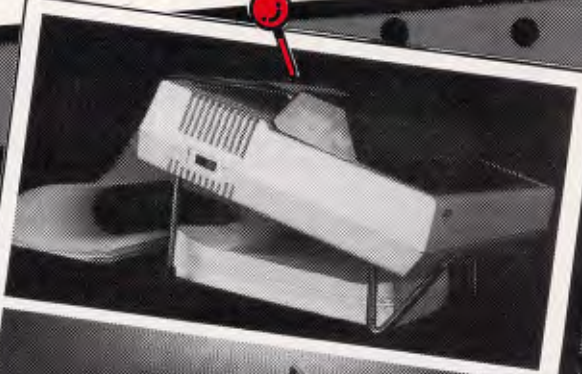

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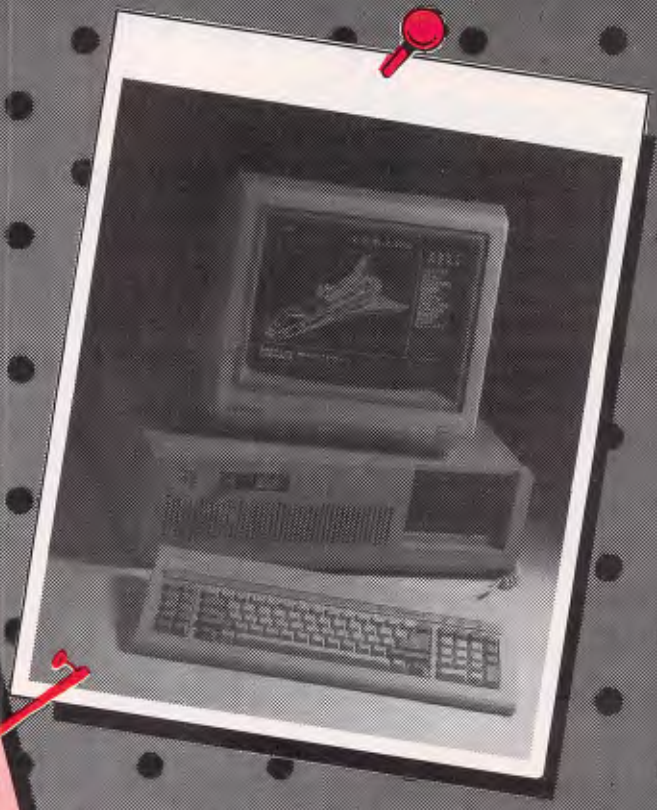

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ensure that the vast majority of network stations will be IBM machines.

There is no question that machines like the Amstrad PC are having a beneficial effect on the end-user prices of software, but they are not a panacea for the home user or small businessman because of their all-in packaging. Is there a small business market that wants to buy boxes instead of solutions? Haven't the retail shops been burnt enough already to know that there *isn't* a home market?

I question who will buy this machine. In the short-run, lots of people. Barring manufacturing and supply problems, it will be moderately successful.

In a year, sellers of the Amstrad PC1512 will be scratching around in educational institutions — which, for many reasons, is the right market for this machine. There will be an alternative Amstrad PC standard to the IBM PC standard which will have moved on with corporate users in tow. The Amstrad alternative standard will enjoy an early old age.

Paul Herzlich.

Attitudes to computer components like keyboards and displays are very much personal matters, and it's good to hear an alternative view to Guy Kewney's.

As with all computers, anyone considering buying an Amstrad PC1512 should make sure that it performs the functions they want before spending one cent. If monitor quality or expandability are important, then try out your software and add-ons first. And if the dealer won't let you, go somewhere else — it's your money.

A fine line

Mr Banks is apparently unaware ('System crash', *APC*, November) that human beings are already redundant.

The Insect Intelligence controlling the infrastructure of this planet (known as Ahriman – the Devil to you) decided many moons ago to phase out the wetware in preference to those nice, new, neat and clean crystalline peripherals you call computers.

The advantages are obvious to a truly competent (and detached) mind. Stop snivelling — are you a man or a machine? It's them or us: power off now, and avoid the rush.

Mike Moscoff.

Pricing policy re-think

Ah . . . The Power of the Press! Further to the letter I wrote to you in June concerning the profits made by some companies by over-priced service charges for copies of public domain software. I have been informed by the PC-SIG dealer in Australia that Technical Imports Australia has now ceased this practice, and is now selling disks of public domain software at the standard price ($11). I also believe that TIA will be an accredited PS-SIG dealer. Now if only the others engaging in such practices would follow suit . . . Thank you again for an excellent magazine, and keep the programming articles coming.

P. Doornbusch.

Wanted: hard-hitting tests

I am prompted to write to you to connect three items which you have published over the past couple of months, that may at first seem unconnected.

Firstly D Bourke (October, *APC* Letters) ridicules Guy Kewney for his 'anti-SDI' remarks. Guy is in the very best of company as a couple of quotes from the 1975 book *Computer Lib —Dream Machine* show:

"THE ABM. Its name has kept changing, possibly to lull the public, possibly to gull the Congress. Anyhow, would you believe a system, totally controlled by computers, designed to shoot down incoming missiles? If you would, read on ..."

There follows a lengthy description of a system variously known as Nike-X, Safeguard, Thin Shield, Spartan and Sprint, which we now know in its rehashed and expanded form as SDI.

The author concludes that: "The system is a Turkey . . . The main reason computer people should take an interest is simple. Only we know how funny the thing really is: ALL THOSE COMPUTER PROGRAMS HAVE TO WORK PERFECTLY THE FIRST TIME".

What Greenie-Commo said that? Why non other than eminent futurologist, genuine computer expert and one-time CIA and DoD consultant, Theodore H. Nelson.

The second item was Guy making the discovery, after four years of ownership, that the corret name for MS-DOS is Mess-DOS. It was once said (pre-CP/M) that we should adopt the *best* DOS, not the *first.* For all its faults, CP/M was a very good first try, but I have looked in vain for any serious counter to the massive bulldust spouted about the 'power' of 16-bits and MS/PC-DOS. Now that everyone has been hyped witless by cybercrud, and the execrable Mess-DOS is a defacto standard, it is too late to start taking a critical look at it.

The third item is the letter (also October *APC*), from N Goddard showing his 20 year old, 12-bit DECmate II benchmarking up there with the Olivetti M24. I did a similar test with my old Alpha-16 mini quite some time ago with the same results, which has led me to a healthy scepticism of claims of 'speed' and 'power'. Adam Greenes' dBase II benchmarks run at less than half the speed of a CP/M machine on a PC (even one with hard and RAM disks!), leading to the conclusion that the machine is processor or OS bound, NOT disk bound.

The point of all this is that *APC* can only serve its readers well when it takes an informed and critical view of what is presented to it. You can depend on the salesmen to tout the advantages of the latest offering and hide the warts. We, the readers, depend on *APCs* writers to tell us what is wrong with the latest Wunderbox, not to gush over it like star-struck groupies. Too often I have had to ignore glowing reviews after finding numerous technical errors that do more to expose the competence of the reviewer than the quality of the product.

That said, credit where credit is due: Guy Kewney, Martin Banks (sometimes), and in particular Kathy Lang and David Taylor seem prepared to go for the jugular, and understand that real people have to use these machines on real and often mundane jobs that don't require colour graphics and polyphonic sound.

Lastly a quote from the *Whole Earth Software Catalogue:* "Bugs in software and documentation are like cockroaches in a kitchen – you never find just one." I expect reviewers to be provided with the best the company can offer, so reviewers should have no mercy with faulty or problematic offerings.

R Roper.

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MS-DOS programming

Our series on MS-DOS internals and systems programming continues. This month, the introduction concludes as Ian Davies takes a look at the processor and of the MS-DOS internal environment.

The processor

One thing common to all MS-DOS machines is the processor. They all run either 8088, 8086, 80186, 80286 or 80386. These chips are all essentially the same, and Intel refers to them as the iAPX 88 and 86 families.

These chips grew out of the original 8080, and to those who have been playing with microprocessors for some time, this will inevitably provoke warm feelings. The 8080 itself grew out of the original 8008, which was a 1971 vintage 8-bit chip, capable of executing an instruction in 20 micro-seconds, presented in an 18 pin DIP package and requiring about 60 additional components to create a minimal system.

The 8080 hit the streets in about 1973. It was delivered in a 40 pin DIP format, and had an execution time of two micro-seconds — an order of magnitude improvement. The 8080 was also an 8-bit processor, but had a 16-bit address bus (64k memory maximum), RAM based stack, and DMA support for fast peripheral data transfer. It provided some 73 instructions, and required only about 30 other components for a minimal system. Although being an 8-bit chip, it could also manipulate 16 bits of data at a time, but did it in two chunks of eight.

All this was happening around the same time as Motorola brought out the 6800, a cute, if slightly backward chip used heavily for training, and Mostek introduced the 6502. The 6502 was a programmer's nightmare, yet found its way into the original Apple II, most video games and, more recently, the Commodore 64. To my mind, the original 8080 was streets ahead of the 6502 and 6800. However, one should not lose sight of the fact that in those days, microprocessors were produced for engineers as an alternative to designing large complex digital equipment. I've still got my original 8080 book from Intel, in which instruction sets and bus impedances are discussed hand in hand.

The 8080 was quickly followed by the 8080A. This was basically the same unit, but was faster and needed only a dozen additional components. This was the big one for Intel, as it wasn't hard for someone to piece together 12 chips on a breadboard and create the heart of a computer. All around the world people were doing this — I did, and it was a heap of fun.

Intel followed the 8080A with the 8085. This should have been even bigger, but sadly for Intel, Zilog had developed its 8080 enhancement called the Z80. This really was a big one, finding its way into the TRS-80 and a number of other trend-setting machines. People like me kept playing with 8080s, as they only cost $9.95 each, whereas the Z80 was around $50. The Z80 provided additional index registers, block move instructions and speed. Additionally, only three other components had to be added for a minimal system. Again, it was an 8-bit system which could address up to 64k of memory and 256 I/O devices.

The Z80 dominated the industry for many years. Intel fought back with the 8086, appearing in 1979. The 8086 delivered another order of magnitude of performance, but more importantly, it was a 16-bit chip. Other manufacturers had brought out 16-bit chips before. National Semiconductor produced the 16-bit PACE chip years before the 8086, but it never really took off. The 8086 could address up to 1 Mbyte of memory, 65,536 I/O devices, had many new internal registers, instructions and addressing modes. Specifically, it provided 14 16-bit registers, 24 addressing modes and 143 instructions implemented in 19,000 transistors. Most significant of all was the fact that the design of the 8086 had been influenced by software considerations.

Importantly, Intel made a point of providing upward compatibility throughout its entire range. Thus even the brand new 8086 had overtones of 8008 about it. Intel did not go so far as to make all the chips instruction set compatible. Instead, the register structure was similar and assembly source for one chip could be run through a converter to make it run on a newer chip.

The 8086 slept for a couple of years, while at the same time, Zilog and Motorola fought back with the Z8000 and the 68000. These chips were the first of the 'super-chips', and both were vastly superior to the 8086. The Z8000 in particular, provided multi-user support through hardware (user and supervisor modes), multi-tasking support (test-and-set instructions), could address 24 Mbytes, and supported virtual memory through its MMU device. Sadly, the Z8000 ran into fabrication problems, and the 68000 ran all over it — finally finding its way into the Apple Lisa and Mac.

The 8086 started going places when IBM selected its little brother, the 8088, for the new IBM Personal Computer. The 8088 is basically the same as the 8086, except its data bus is eight bits wide. Internally, it still has 16-bit registers, but storing a 16-bit value to memory is done in two parts, just like the original 8080.

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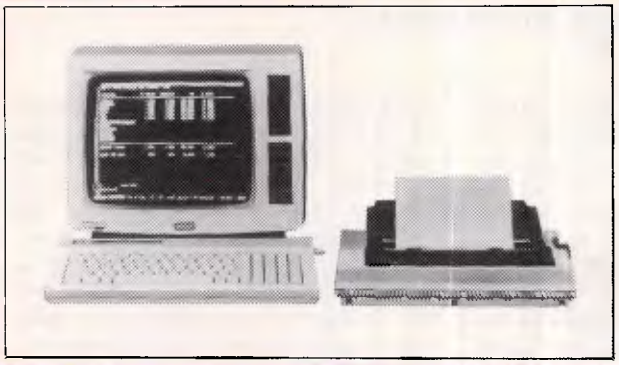

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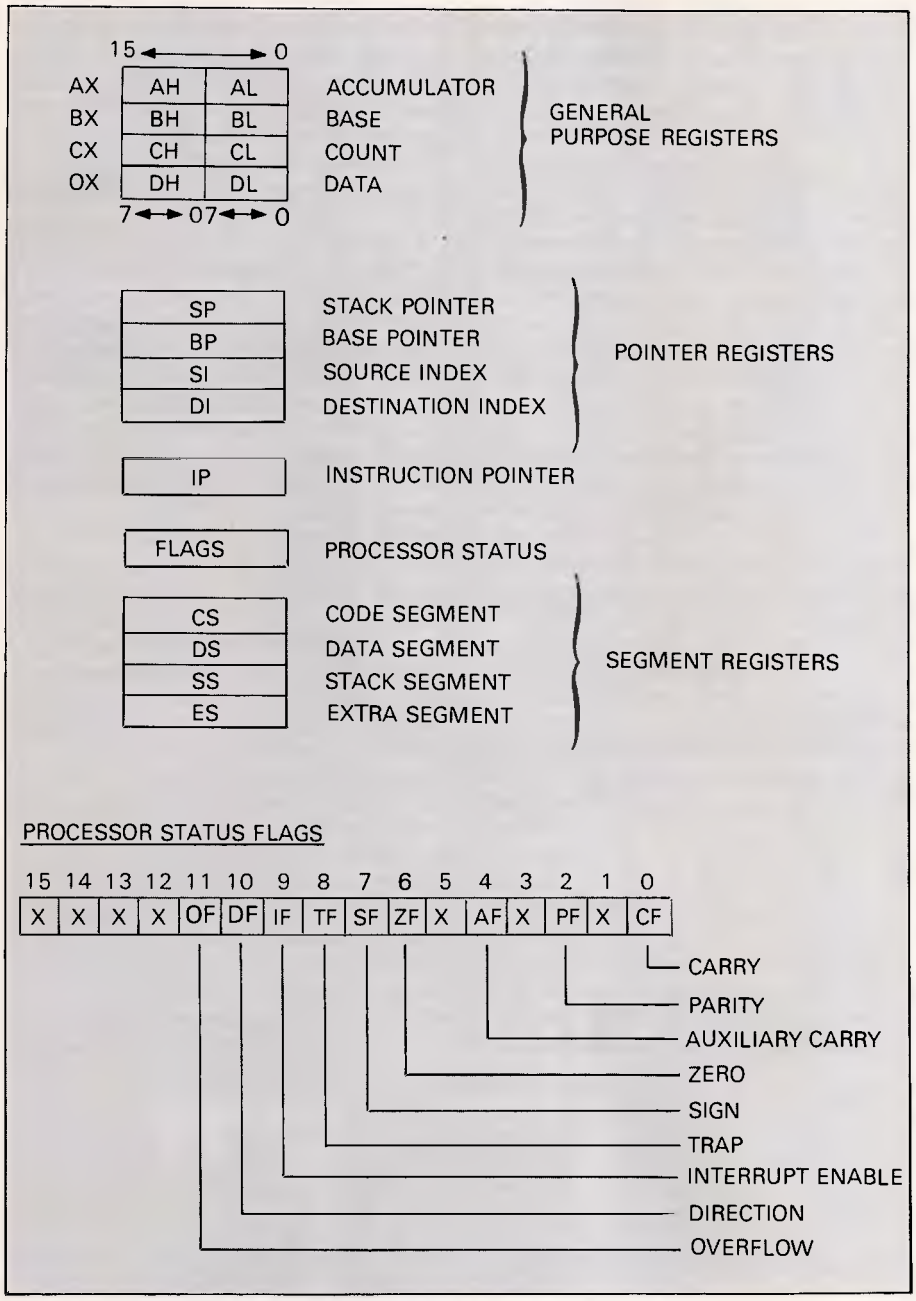

Figure one: The 8086 register structure

It's a mystery why IBM chose the 8088 instead of the 8086. True, the 8086 requires 16 data lines running throughout the machine, but this is trivial.

Since the 8086 can store 16 bits of data at a time, it runs twice as fast as the 8088 where 16-bit operations are involved. For instructions which transfer only 8 bits, the two run at much the same speed. Thus, how the software is written can greatly influence how much faster the 8086 is. Despite this however, the 8088 and 8086 have identical instruction sets and can be considered to be the same chip from the programming point of view. This is why many compatible vendors have chosen the 8086 and have achieved enhanced performance.

The 80186 was not a significant device, mainly being an 8086 with more of the support circuitry 'on-chip', rather than residing in additional packages. This lowered manufacturing costs and meant smaller circuit boards.

The 80286 was a real improvement. It can address up to 16Mbytes of memory and provides hardware support for multi-tasking and multi-user environments, and is the chip chosen for the IBM AT. Moreover, much of the support gear has been moved back off the chip, and additional 'smarts' have been placed in the chip to perform instruction pipe-lining, a feature normally only found in mainframes and minis. Really, the 80286 is two chips in one. It can either be considered as a fast 8086 single user device (as it is in the AT), or can form the basis of a true multi-user system, as could be done in the AT, but no-one is using it that way.

The 80386 is where Intel finally catches up to the old Z8000. This chip out-runs most minicomputers. It can address up to 64 gigabytes of real memory, has on-chip support of virtual memory up to 64 terabytes, and goes faster than many $200,000 mini-

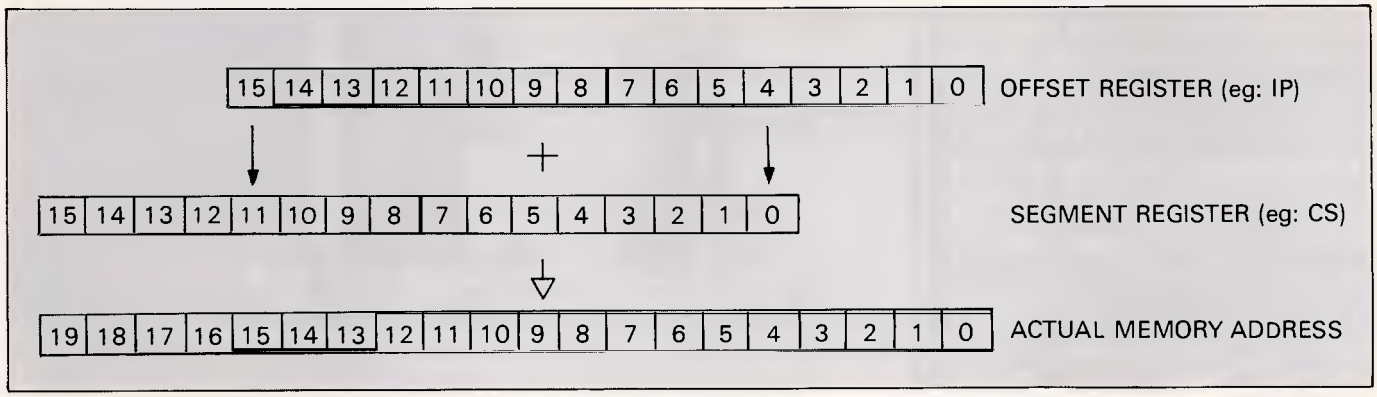

Fig 2: How the segment registers affect memory references

computers. Internally, the chip reeks of being designed for a true mini environment. Intel plans to use the 80386 to get into the computer systems business, and might just do it — the 80386 is a very impressive device.

The 80286 and 80386 both provide instructions not present in the 8088/86; however, they do implement all of the 8088/86 instruction set. This means that (in general), anything written for an 8088/86 will run on an 80286/386. This is why PC software happily chugs away on the AT.

Throughout this series, we will refer to the 8086, but in our context, the comments can also be applied to the 8088, 80186 and 80286.

The 8086

To do anything adventurous with MS-DOS or the Bios generally requires the use of assembler. Except for 'terminate and stay resident' software, the MS-DOS and INTR functions of Turbo Pascal can greatly reduce the need for this, but even so, knowledge of the 8086 structure is a must. Old 8080 and Z80 enthusiasts will find much of this information hauntingly familiar.

The 8086 contains 14 registers, as shown in Fig 1. Although their names reflect specific functions, most of these registers can be used for most activities. For example, arithmetic can be performed on any general purpose or pointer register, and general purpose registers can be used as pointer registers.

The four general purpose registers can be treated either as 16 bits, or as two groups of 8 bits. As the registers are only 16 bits wide, Intel must employ a slight trick to obtain addressability to 1 Mbyte. This is done using the segment registers. Simply, whenever memory is referenced in any way, whether it be by the stack, IP, or a pointer, the 8086 adds one of the segment registers to it. However, the segment register is first multiplied by 16. The effect is shown in Fig 2.

Thus two 16-bit quantities combine to generate a 20-bit effective address, thus providing access to up to 1 Mbyte of memory. For example, if the segment register CS contained $1234, and IP contained $4567, then the actual byte of memory accessed would be $168A7. All memory addresses are actually written in segment offset form, for example $1234:4567.

This has two interesting side effects. One is that any unique location in memory can be expressed in 4096 different ways. For example, $1234:4567 and $1334:3567 actually refer to the same memory location. The other is that the scheme tends to break memory up into 16-byte areas, as segment registers can only point to 16-byte boundaries. This quantity of 16-bytes is called a paragraph, and makes relocation a breeze.

Anyone from the Z80 days will remember the problems of relocating a program from one area of memory to another. In the 8086, however, as long as the program does not load absolute values into any of the segment registers, programs can be relocated simply by moving the program to the desired starting paragraph, and then loading the segment registers with new values.

It's important to remember that you simply cannot get at a memory location without first having a segment register pointing to within 64k of that location. This is why four segment registers are provided. Their functions are:

CS — points to the executable code being run
SS — points to the stack
DS — points to the data being operated upon
ES — points to anything else

ES is probably one of the most important registers, as it allows inter-segment operations to be performed.

Each instruction in the 8086 uses a default segment register. For example, CS and IP are generally paired, as are SS and SP. Direct addresses and indexing via most pointer registers default to the DS segment register. Some move and compare instructions using DI and SI default DI to ES and SI to DS. The BP register generally defaults to SS, and this is really neat, as it makes the 8086 very applicable to stack-frame based languages such as Pascal and PL/I.

Importantly, segment register defaults can be overridden. Internally, this is done by a one byte prefix instruction. In assembler, it looks like:

MOV AX, CS:[THING]

The 24 addressing modes are generally broken into seven categories, as shown in Fig 3. Some of these appear to be inconsistent, for example, the machine does not allow a segment register to be loaded with a constant (for good reason). This apparent inconsistency is due to the fact that there are really 24 modes, and they are shown in seven groups.

The instruction set in the 8086 is similar to many other microprocessors. Its distinguishing features include signed and unsigned multiplication and division instructions, and a complete set of conditional jump instructions which take care of different flag combinations and are duplicated for signed and unsigned comparisons. All JMP and CALL instructions exist in different forms (with different lengths), depending on whether the transfer is inter or intra segment.

256 software interrupts are provided. These are very important, as they are the basis of how MS-DOS and the Bios work. Software interrupts are one or two byte instructions which behave much the same as external interrupts. Issuing one

Mode	Operand Format	Default Segment
Register	Reg	None
Immediate	Data	None
Direct	Disp	DS
	Label	DS
Register indirect	[BX]	DS
	[BP]	SS
	[DI]	DS
	[SI]	DS
Base relative	[BX]+Disp	DS
	[BP]+Disp	SS
Direct indexed	[DI]+Disp	DS
	[SI]+Disp	DS
Base indexed	[BX][SI]+Disp	DS
	[BX][DI]+Disp	DS
	[BP][SI]+Disp	SS
	[BP][DI]+Disp	SS

Notes: Reg can be any 8 or 16-bit register, except for IP
Data can be any constant, 8 or 16-bits in length
Disp can any 8 or 16-bit signed displacement value, and is optional for base indexed addressing

Fig 3: The 8086 addressing modes

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causes the flags, CS and IP to be saved on the stack, and control transferred to a vector specified in the first 1024 bytes of memory. For example, INT 21H picks up the vector stored at $0000:0084 and causes execution to commence at that point. All major MS-DOS and Bios entry points exist as software interrupts. As the vector table exists in RAM, you can change the vectors to define your own system service handlers.

Other instructions include the so called 'string' compare, search and move. These allow strings of either bytes or words to be moved and compared in a single instruction. It's all rather clever, and exceedingly fast. You simply point SI at what you want to copy, DI at the destination, CX with the number of bytes or words, and execute the instruction:
REPNZ MOVSB

The REPNZ is a one byte prefix which causes the following instruction to be executed until the specified condition is true. Tables can also be searched in much the same way. On the 8086, using MOVSW (word) instead of MOVSB (byte) greatly enhances performance due to the 16-bit data paths. The 8086 automatically takes care of decrementing CX, and will either increment or decrement DI and SI, depending on the setting of the direction flag in the status register.

The stack architecture allows not only any register to be PUSHed and POPed, but also any arbitrary operand.

The 8086 is far from the best processor around, but it's certainly the one everybody uses, and provides enough elementary facilities to get the job done, in addition to a number of really good facilities to get the job done well.

MS-DOS calls

We have said that most decent software exploits the machine resources at three levels: DOS, Bios and hardware. This section discusses some generalities of the MS-DOS call interface, and examines the historical causes of its peculiarities.

The first thing to realise is that Microsoft did not write MS-DOS. In the heady days before the release of the PC, IBM went hunting for an operating system. CP/M was the accepted 8–bit operating system, and CP/M-86 seemed destined to fill the same bill in the 16-bit arena. To the surprise of many, including Microsoft, IBM did not take the obvious step of putting CP/M-86 on its machine as the preferred operating system. Instead, it formed an agreement with Microsoft. This was mainly due to Digital Research's reluctance to play the IBM negotiating game and Microsoft's willingness to stand in awe of IBM. In late 1980, Microsoft, purveyor of fine Basic interpreters that it was, bought an operating system called SCP-DOS from Seattle Computer Products. This was to become MS-DOS version 1.

Version 1 was a rather boring, low powered operating system developed in a hurry. It seemed to offer no great advantages over CP/M-86 and internally resembled its competition in many ways. For about eighteen months, the industry speculated whether MS-DOS or CP/M-86 would win the day. Although CP/M-86 is still around today (somewhere), you don't see much speculation.

Version 2 of MS-DOS offered great improvements, including new ways to access files, memory management, nested non-concurrent tasks and a hierarchical directory structure. It seemed to draw heavily on Unix ideas, but had to maintain the arcane version 1 facilities to achieve compatibility. This seemed to be the true direction intended for MS-DOS, and started to differentiate it from CP/M-86. The hurried release of the early version 1 did, however, created a bugbear which MS-DOS has been forced to carry around ever since.

Despite all this, it is poetic that the operating system has never offered the full capabilities required to exploit the screen, keyboard, serial and printer ports, and that software developers have been obliged to bypass DOS for most of their clever bits. While this situation is slowly changing with the emergence of Microsoft Windows, developers must still write for the lowest common software environment.

Because of all this, MS-DOS calls in terms of their parameters, results, error handling and file specifications fall into pre-DOS 2 and post-DOS 2 formats. In fact, one very quickly realises that there *is no standard* when it comes to DOS calls, and the manual must continually be referenced to check individual call formats. This situation improved markedly with the DOS 2 calls, and even more so with the DOS 3 calls, but as DOS 1 calls must still be made, the confusion persists.

One of the greatest areas of change has been in file handling. The original DOS was based around the CP/M concepts of File Control Blocks (FCBs) and Disk Transfer Areas (DTAs). Before a file can be opened, an FCB is created and loaded with the relevant file name. Registers are pointed at the FCB and DOS is called to open the file. Before an I/O can be performed, a buffer must be allocated and DOS is again called to declare the buffer to be the current DTA, only one of which can be active at any one time. Finally DOS can be called to perform the actual I/O, with registers pointing at the FCB. After each DOS call, the AX register is either loaded with zero to indicate successful completion, or with an error code. The meaning of each error code varies depending on the call.

Since only one DTA may be the current one, and since most applications have multiple DTAs, and since it is a hassle to keep track of which of your DTAs is current, most applications are written to *always* reset the DTA before the I/O call. Non-file sharing versions of DOS make no attempt to keep track of FCBs, and so a program which does not close its files upon termination or a crash cannot expect DOS to do so for it. Moreover, the FCB has no capability of handling the hierarchical directory structure of file names, and so files can only be opened in the current directory, even though the current directory may be altered once the file is open.

Despite all this, the FCB approach to file I/O can provide certain advantages. For example, record lengths can be specified and all I/Os done in terms of records rather than bytes. Similarly, the fact that DOS does not keep track of FCBs can be an advantage in some memory resident utilities. Additionally, FCB I/O can, at times, be more efficient than the alternative, and provide more information about the file. For these reasons, many applications still use FCB I/O. Figure four shows the structure of an FCB, which may be either a normal or extended FCB, the extended form being used to access invisible and protected files.

The new form of file handling corresponds to a Unix concept, and is based on file handles. To use a file, registers are simply pointed at the ASCII file name terminated with a binary zero (ASCIIZ), and the file is opened. Upon return, DOS passes back a sixteen bit token, or handle, which may be used to refer to the file from now on. The ASCIIZ name may include directory notation, and is no longer required once the handle has been returned. I/O requests are made simply by loading a register with the handle and pointing a couple of other registers at the desired buffer. Since DOS keeps track of file handles, it will automatically attempt to close all files upon program termination. Error codes are always passed back in the AX register, with the carry flag being set if an error occurred. The meaning of error codes is the same no matter what the call. Four standard handles are defined corresponding to standard input, standard output, error output and the printer.

Microsoft strongly recommends that the newer handle-based I/O is used in preference to FCB-based I/O, but the

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decision is not that clear cut, and software producers do what they must.

In short, today's MS-DOS is a mish mash of SCS-DOS, MS-DOS versions one, two and three. This can make it a little tricky to get into, as MS-DOS seems to offer duplicated system facilities with little consistency. Things are certainly improving, and the new MS-DOS version 5 should go even further in the migration from CP/M to Unix concepts.

For the moment, however, the cosmopolitan background of MS-DOS offers developers a rich collection of facilities and a constant choice of approach.

The MS-DOS interface

MS-DOS itself is accessed through eight different interrupts. These are:

INT 20h This interrupt causes the current program to terminate. It resets the critical error handler to the system default, flushes buffers, and releases memory. It is the users responsibility to ensure that all files are closed prior to making this call. This is a v1 call, and other mechanisms exist (through the function dispatcher) which are preferable.

INT 21h This is the main function dispatcher for MS-DOS, and will be discussed later.

INT 22h The address represented by this interrupt controls where to jump to when a program finishes executing. In v1 days, a program could load up another program, set INT 21h to point to its entry point, and then terminate itself, thereby causing the other program to run. V2 provides a better way of doing this through the function dispatcher.

INT 23h This is where the system goes when the Control and Break keys are pressed. Normally this is a handler provided by DOS, but most compilers insert their own handler. Most software products also set up their own handler, and you can often follow around after the product and reset INT 23h to your own handler.

INT 24h This points to the critical error handler, which is responsible for the message:
"Error ..... Abort, Retry, Ignore ?"
You can also define your own handler for these errors, as many products do. Your handler can even check the type of error, and then either take its own action or pass control back to the normal error handler.

INT 25h This one provides a sector based interface for reading disks. It accepts a starting sector number, a length, a buffer address and a drive number and either performs the I/O requested or passes back an error code. It is device independent, in that it doesn't matter what type of hard disk you are using. It is used by the DOS function dispatcher. Some products which access disk directly, such as the Norton Utilities, use this function to read the boot sector.

INT 26h Provides the write sector equivalent of INT 25h.

INT 27h Another function superseded by v2 facilities. This used to provide the ability for a program to terminate and stay resident, that is, the program would finish but the memory it occupied is not given back to the system pool. This ability is the backbone of many of the nifty things we'll be doing in this series.

MS-DOS function dispatcher

There is really quite a lot to say about interrupt 21h, as this is where most of the MS-DOS facilities are provided.

The MS-DOS calls shown below are not exhaustive, and are only described in brief. More detail will be entered into as we develop utilities which make use of them.

Remember, all of these facilities are accessed through interrupt 21h, and the register AH is set to the desired function code.

- Function number zero is exactly the same as interrupt 20h, that is, it terminates the current program. It requires that the CS register is set to point at the programs PSP (Program Segment Prefix — we'll be looking at this later).
- Function 01h waits for a key to be pressed, echoes the character to the display and returns the result in AL.
- Function 02h takes the character in DL and displays it. This is a very inefficient way of displaying output — function 09h is much better.
- Asynch input is performed by function 03h. This is of little use as it waits until a character is received and does not provide useful control over time-outs.
- Function number 04h performs output to the asynch port, and is of about the same amount of use, as it provides no control over what modem control signals must be present. The Bios provides far better facilities for asynch I/O.
- Function call 06h combines functions 01h and 02h. Additionally, it will return even if a key is not pressed. If register DL contains 0FFh, then this function performs input, otherwise it performs output.
- Function number seven is similar to function 01h, except it does not echo the character.
- Function eight also does the same thing, except it does not check for Control Break.
- The efficient way of displaying output is through function 09h. This one takes the string pointed to by DS:DX and displays it, up until a terminating dollar sign.
- Function call 0Ah accepts a complete line of input. DS:DX points to a buffer whose first byte contains the length of the buffer. Full MS-DOS editing is provided during input, and upon return, the second byte of the buffer contains the number of characters actually entered.
- Function number 0Bh checks to see whether a key is pressed and returns 0FFh in register AL if so.

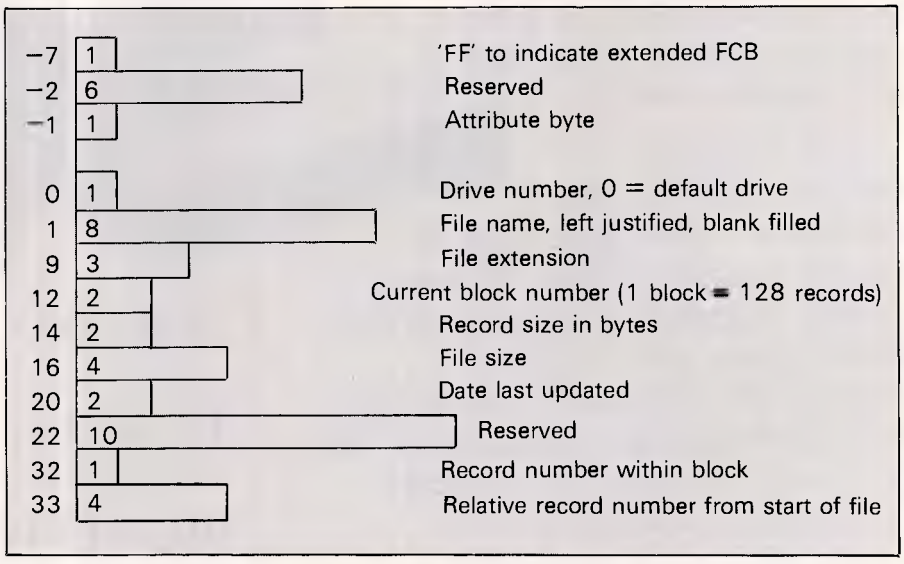
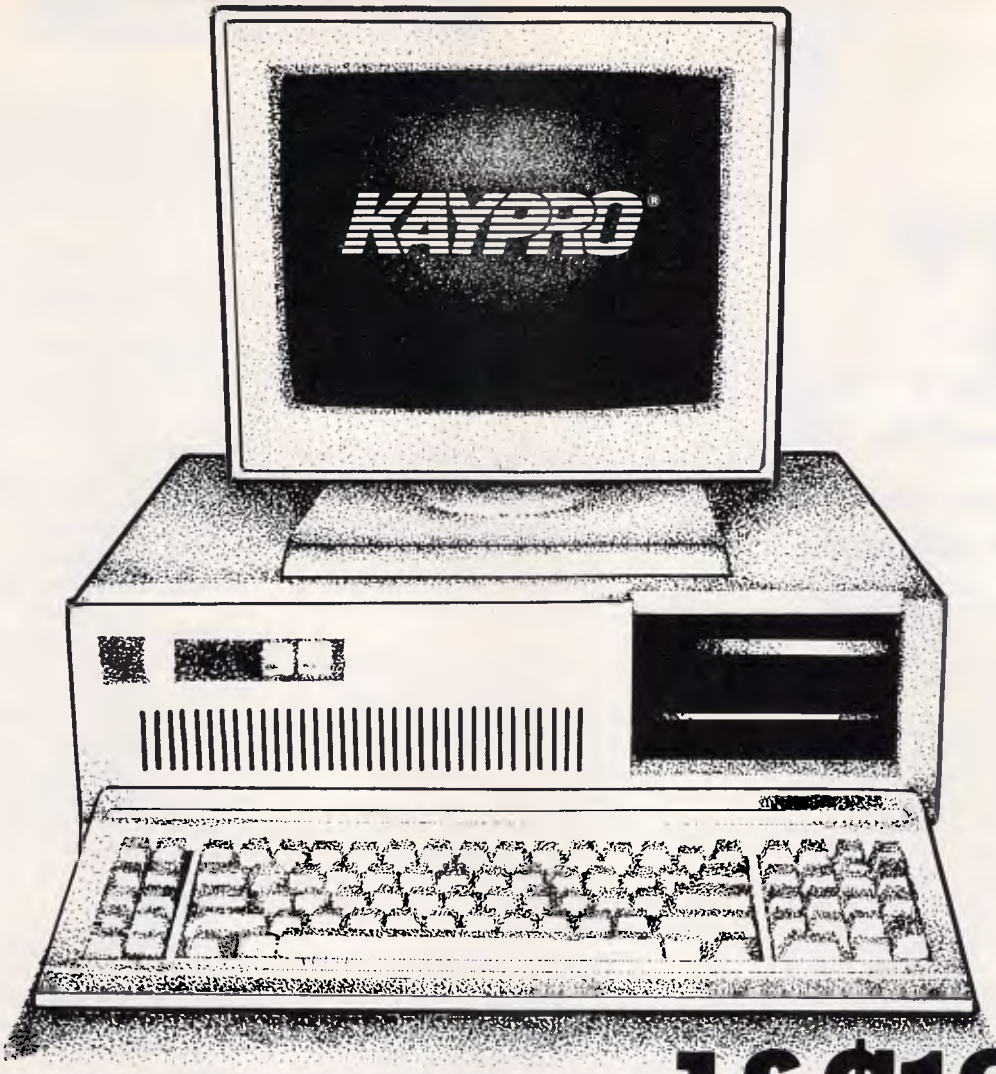


Fig 4: The structure of an MS-DOS FCB



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```
195     ON ERROR GOTO 510
205     ON ERROR GOTO 0
510     RESUME NEXT
```

Fig 5: Modification to the loader program.

- Function number 0Dh flushes all disk buffers to disk, but does not close any files. If this call is made and an open file has been extended, the directory will not be properly updated and CHKDSK will detect errors.
- The current disk is selected through function call 0Eh. Register DL is loaded with a drive number, where 0=A, 1=B, and so on. As a side effect, AL contains the total number of drives upon return. The current drive can be determined through function 19h, which returns a result in AL.
- Function call 0Fh is the old FCB-based method for opening files, and its counterpart is function 10h for closing files. An alternative function call is 16h, which opens a file and creates it if it doesn't already exist.
- Functions 11h, 12h, 21h, 22h, 27h and 28h provide the FCB-based way of searching for files. The FCB is loaded with question marks in the appropriate places prior to the call.
- Function 13h allows deletion of files through an FCB, and function 17h allows them to be renamed.
- I/O through FCBs is performed through functions 14h and 15h. These functions both require a DTA to be set up first, which is done through function 1Ah.
- Function call 1Bh returns the first byte of the current disk FAT. The FAT, (File Allocation Table) is always set up so that the MDB, (Media Descriptor Byte) is at the front. This byte can tell you many interesting things about the disk. To determine the MDB for any drive, function 1Ch can be used with the drive number in register DL. Later, we will be taking a close look at disk directory and FAT formats.
- Function 25h is one that we'll be using rather a lot. It allows you to change an interrupt vector. This isn't as easy as it seems, as it is possible that a vector will be used while you're in the middle of changing it. Function 35h matches this one, and lets you determine the current setting of a vector. By using these two functions, it is possible to insinuate your own software right into the middle of MS-DOS.
- Function call 29h was a very useful one before the ASCIIZ-based file I/O calls came along. Its purpose is to parse an unstructured file name into a structured FCB.
- Date and time manipulation are provided through calls 2Ah, 2Bh, 2Ch and 2Dh.
- Function number 30h returns the MS-DOS version number. This function does not exist in MS-DOS v1, but if you happen to issue it under v1, zero is returned in AL.
- Another function we will be making good use of is number 31h. This allows a program to terminate, but still remain resident in memory.
- Functions 39h to 44h provide all the new ASCIIZ-based file functions, including the equivalent of CHDIR, MKDIR, RMDIR, in addition to open, delete, rename, read, write, seek and close. These are very much easier to use than the old calls.
- Function call 4Bh is another we will be looking at in detail, as it allows any other program to be run from within a currently running program.

Bludner

The inevitable gremlin seems to have struck the Basic program presented last month for the generation of .COM and .EXE files. Figure five shows three lines which must be added to rectify this problem.

We have had a few calls from people who solved this problem, but still could not convince the clock program to generate correctly. These problems involved the loader program complaining about incorrect data. Check your listing against the magazine very carefully, paying particularly close attention not to confuse the character B, 8, 0 and D. These can appear very similar in listings, and quite often asking someone else for a second opinion can resolve ambiguities.

Conclusion

That completes the introductory portion of the series. In coming months, particular aspects of the DOS, Bios and hardware will be examined in the light of practical examples. We'll be looking at disk structures, the difference between EXE and COM files, device drivers, pop-up utilities, screen handling, dBase enhancements, device drivers, FATs, MDBs, PSPs, enhancements to the BAT file processor and much more.

Next month, we take a look at the Bios and present a program which influences the speed of, the machine.

END

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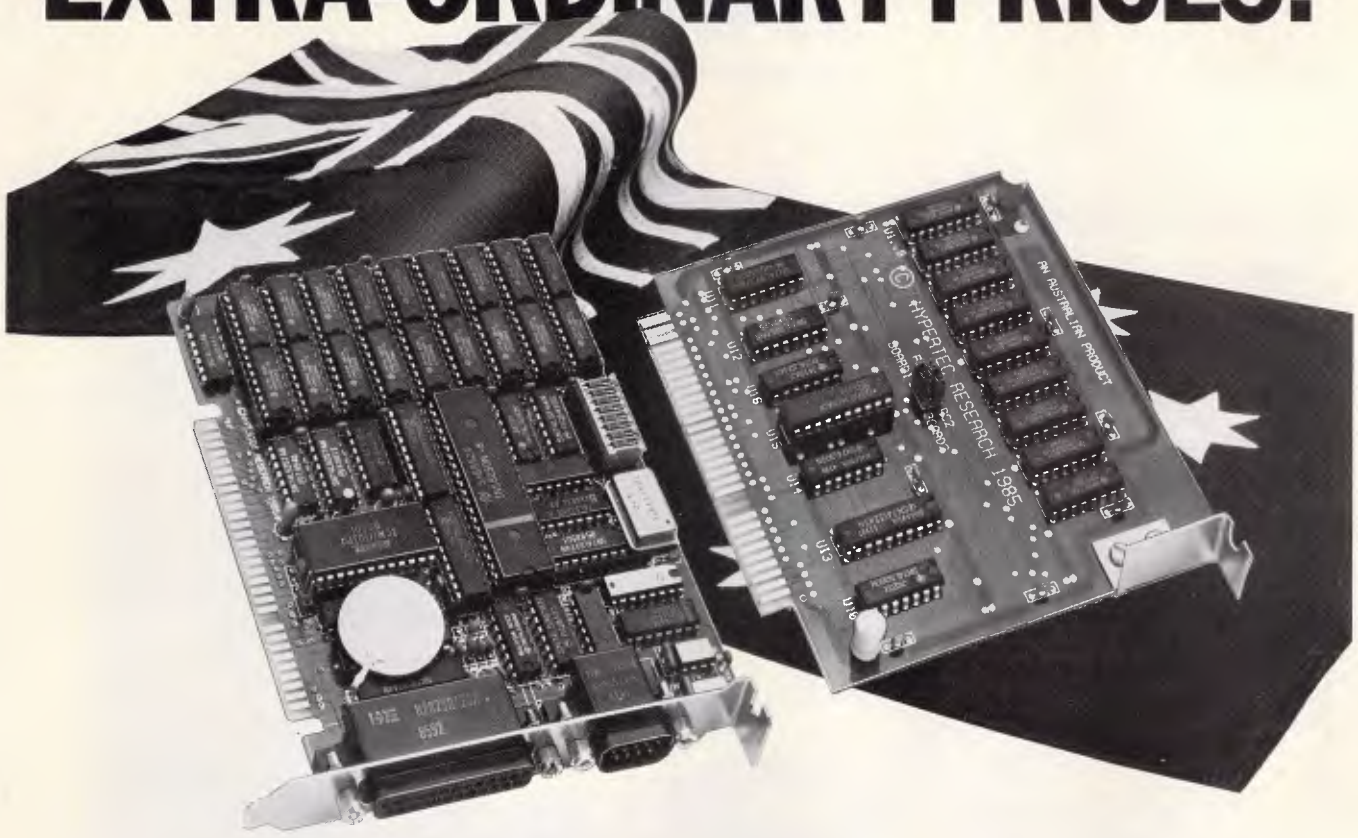

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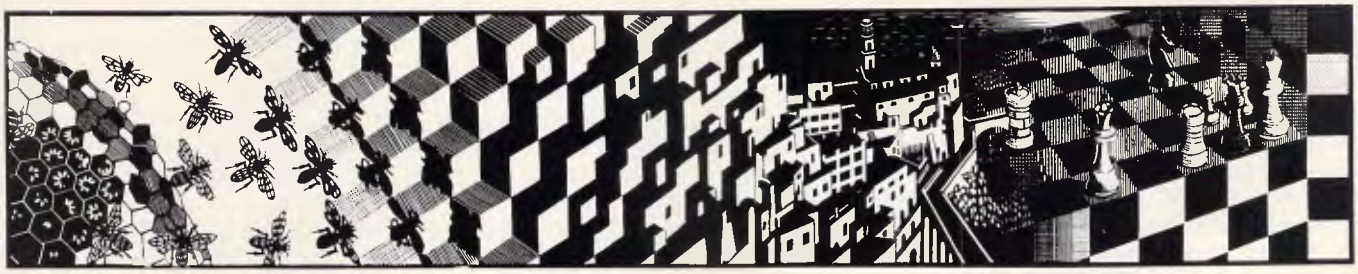
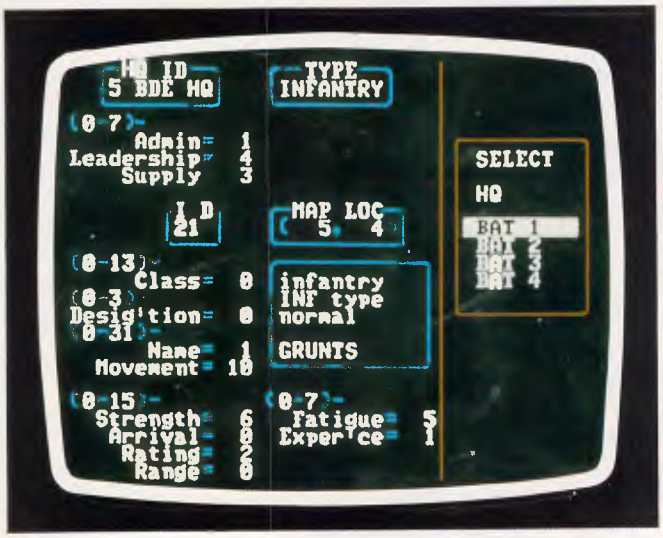


In keeping with this month's 'buy it for Bob' theme, Kevin Bergin reviews two Australian made strategy war games — based ironically enough, in foreign lands.



More world war

TITLE: Battlefront
COMPUTER: C-64, Apple II (family)
SUPPLIER: Strategic Studies Group
PRICE: $40.00

Battlefront is another war game from Strategic Studies Group. Again it is a disk based game and is in very much the same format as Carriers at War. Both of these games were designed and written by Ian Trout and Roger Keating, which may account for their similarity. Battlefront was released this year and looks set to do well, as it is far superior to the award winning Carriers at War.

The overall scenario is World War II, and the players can choose to fight at Crete, Stalingrad, Saipan or Bastogne. The game is supplied with cards depicting the scenes above, and terrain markers.

Like Carriers at War this is a menu driven game in two different categories: Start and Game. The Start menus are labelled A to K and control the structure of each game. The game can be played by two creatures with arms, legs and all the rest, or by the machine, using the observe mode.

The length of each game is limited by the number of moves available which means you have X moves in which to get your act together, or else leave this mortal coil forever.

Playing a game is simply a matter of booting the program and selecting Game from the initial menu, then choosing a scenario from the next menu. At this point you must decide which battle to fight (or replay and change history).

The menu displays the four scenarios on the right, with accompanying details to the left. Selecting a scenario takes you to a menu with Edit or Start options. Choosing the Edit option takes you on to a handicap selection for both sides, and then on to player selection; of which you can choose two players, one player or Observe, where the computer plays itself. Having set the initial parameters of the game, you are ready to start playing.

What happens at this point depends on the play mode. If you have selected Observe then you could go and do something else while the game is played out, but if you stay and watch you will probably get a better idea of the way the game works.

Each player has to cycle through the various menus to deploy forces. The play can take place during the day or at night and a series of reports can be obtained on each of your divisions. Objective shows your position in relation to your objective, and 'map walk' allows you to use keys to wander around the scenario and collect information on your enemy.

Having done this, you can now relay orders to your forces. This is achieved division by division, and before giving orders you may move your HQ, examine, assign or reassign assets, and most importantly, examine/designate support points to available regiments. To stir up each regiment you select the Regiment Orders option, and choose the action for the next turn in the game. This panel will also indicate the regiment's current status (engaged or contacted).

Depending on the status of each regiment and their condition (ranging from alive and well to dead and buried), the regiments are given their next plan of action. They can be redeployed, or used as a reserve or alternatively an enemy

target can be selected for attack. Those forces already engaged can be set to attack, defend or delay. In attack mode, they may 'probe' (gently attack), 'prepare' (minor attack as a diversion before real onslaught), 'assault' (full scale attack), or 'exploit' (sure of a victory, this allows you to be in the best possible position after the enemies defeat).

The above procedure is carried out for each available division, until both sides' forces are ready, then back to the first game menu and commence battle. Each turn is shown graphically in terms of regiment moves, and reports of engagements are given as the fighting continues. After each turn, the reports should be studies before setting forces for the next fight. The game ends when the number of turns is completed, and the winner is the side with the highest victory points.

As with Carriers at War, Battlefront has an extensive 'create' facility, allowing experienced war game players to set up their own scenarios and save them on separate disks. Using the 'create' facility provided, it is fairly easy to set up new battle situations or edit those that already exist. Like the main game, the design utility is menu driven, and takes you through all of the options contained in the game and allows you to redefine them to suit your own tastes.

The manual supplied is small but very good, and even novices should not have too much trouble playing Battlefront. For those who need advice, RUN 5 will no doubt shed light on some issues, but if you get really stuck then no doubt SSG will be glad to assist you. Battlefront is a very playable game and is certainly worthy of a place in any games library.

Pearl Harbour revisited

TITLE: Carriers at War
COMPUTER: C-64, Apple II (family)
SUPPLIER: Strategic Studies Group
PRICE: $50.00

Strategic Studies Group, an Australian company specialising in war games, or games of strategy, has had a good deal of success. Carriers at War was awarded Game of the Year status and has sold particularly well in the United States. So, if you are tired of your arcade games encountering death, doom and disaster then you can create your very own holocaust with Carriers of War.

The version reviewed was for the C-64, but there are also versions for the Apple II family. You will need a disk drive for this game, and it would help if you have a turbo loader available. The game is controlled via a sequence of menus, and comes preset with six scenarios or battles. All of the scenarios are based around Fleet Carrier Operations in the Pacific between 1941-1945 ... ah yes, remember it well.

The object of the game is to select one of the historic battles and set up your forces. All menus are depicted on the right of the screen and the player can edit a variety of options before commencing play. In play the majority of the screen display is a graphical representation of the battle. This is disappointing as the graphics are very poor, especially as most of us have been spoilt in the last few years with excellent graphics on the 64. However, SSG says they concentrated on the game's performance and creation facility; which meant sacrificing the screen displays, as there was not enough memory. Which is, in fact, the case. The game does use all of the Basic RAM, as well as most of the shadow RAM.

The preset scenarios include Pearl Harbour: a classic battle between the merciless Japanese fighters and the USA naval forces. As with all of the battles, there can be one, two or no players! One player pits his strength against the computer, while the two player game enables you to destroy your best friend. If no players are defined (ie computer vs computer), then the battle is fought by the computer, with the only intervention from human hands being the redeployment of forces. The other five scenarios are all Japan vs USA in the Pacific, with varying odds on either side.

Players can take either side and set a number of options before commencing. SSG provides a series of cards to help you find your way through the game. The most important one at the start of the game is the menu card, which allows you to see at a glance the possible selections that can be made at any one point.

The players set their forces via the various menus and commence play. The play can be interrupted at any point, and reports for either side can be obtained. Planes can be armed, a target set, then launched against that target.

While the action commences players can study the activity as it happens by interrupting the game and examining their forces. It can be fascinating to watch the planes being prepared for launch. All action is depicted on the screen, and the game is preset for a number of hours and ends with a report by points.

The most interesting feature of this game is the ability to create your own scenarios. At first this is quite a daunting task, but the program is sufficiently well designed to assist you. To customise a battle, the Create menu is selected at the start of the game, and the map and data information is cleared. The skeleton of the battle is saved to disk and the maps and data are rebuilt to your specificiations and saved to disk for future use.

Carriers at War is supplied with two good manuals. One is a player manual, which serves as an introduction to the game and as a reference manual. The other is a design manual to aid you in the creation of new scenarios. SSG provides four battle maps, a menu card, and several labels for game disks. SSG also publishes a quarterly magazine called RUN 5, which lists its products and has news and examples of war games and scenarios. Carriers at War is a game that takes time to master, but performs very well, and it sure beats the hell out of death, doom and disaster.

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Available for IBM and compatibles. **Price: $104*.**

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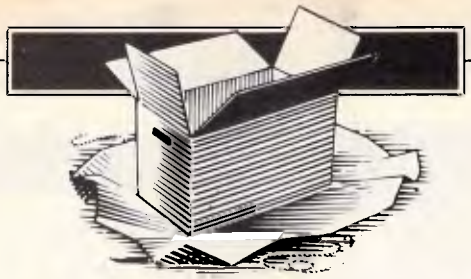


WHAT'S NEW

Ian Davies checks out the most interesting new micro products announced over the last month.

Microcomputers

80386 turbo card

Porchester Computers has announced the availability of the first 80386 add-on accelerator card for the IBM AT and compatibles.

The Jet 386 runs a 16 MHz 80386 providing three times the performance of a standard AT, and twice that of a VAX 11/750. To compensate for the lack of a 32 bit data bus, the Jet 386 includes a 64k cache of 32 bit wide memory. Performance is enhanced on naturally fast computers, as these tend to provide faster memory chips and peripherals. Orchid, the designer of the board, says it has attempted to provide both a fast 80286 compatible system as well as supporting whatever it is people will want to do with 80386 devices in the future.

At an estimated Australian price of $2950, the board certainly isn't cheap. But then, speed is speed.

Porchester is on (03) 537 2722.

T1100 Plus enhancements

The Toshiba T1100 portable personal computer has been put through the wringer to come out as the improved T1100 Plus, and locally manufactured hardware options are now starting to appear.

The T1100 Plus features an improved LCD screen, 256k as standard expandable to 640k and a switchable 7.16 MHz processor speed. It is still delivered in a compact 4.5 kg package.

Most significantly for people who compute on the run, an internal modem is now available, making the T1100 almost unique in the Australian laptop market. The modem, manufactured by NetComm, features automatic dialling and V21/V23 support, thereby allowing access to 300 bps hosts and 1200/75 bps videotex systems.

The T1100 Plus is priced at $3,385 and the modem is an extra $720. Toshiba's number is (02) 887 3322.

Telecom ComputerPhone watch out

You may have seen Telecom touting its undesirable and over priced ComputerPhone for quite a few thousand dollars. If the idea appealed to you, but the price didn't, take a look at this little box and prepare to be blown away by the price tag.

The Microbee TeleTerm is a desk top workstation comprising word processor, communications software, built-in V21/V23 modem, electronic notepad, phone number index, calendar and communications software. All of the software is resident in ROM for instantaneous activation from pull down menus. A voice telephone is included and built into the 92 key keyboard. The communications software can emulate both ASCII and Videotex standard terminals.

Now, how much would you expect to pay for all this? $6,000? $4,000?

Guess again. Microbee is asking just $828, including sales tax. That's quite incredible. A monochrome monitor costs $149 extra, or colour may be added for $448.

Form a queue for Microbee on (02) 886 4444.

Wang Portable PC

Wang has announced a surprisingly attractive portable computer.

The PC portable weighs just 6.5 kg, yet includes an 80 x 25 LCD display, 10Mb hard disk, 512k RAM, built in MX-80 compatible printer, rechargeable batteries and an 8 MHz 80C86 processor. Memory can be expanded to 1Mb, and various floppy disk and modem options are available.

Since the original Wang PC was not an IBM compatible, the portable has had to become compatible with both the IBM and Wang standards. Apparently, when a program is loaded, the machine determines whether it should be IBM or Wang compatible and switches to the appropriate mode.

Most surprising of all, the price is just $5,220, including tax. Wang is on (02) 925 5678.

Who's James Dibble?

One of the most common cries in the modern computer industry seems to be "Who's James Dibble?".

In case you haven't noticed, Mr Dibble forms the spearhead of Epson's advertising strategy, constantly appearing on TV and radio telling us that he thinks Epson gear is great. Who is he and why should he know? Beats me. However, the latest Epson brochure features no less than *seven* pictures of James Dibble. James Dibble meeting the president of Seiko, James Dibble strolling past the Epson building, James Dibble wearing a hardhat and getting his finger caught in an assembly line machine. Strange.

Anyway, James Dibble will be joining us again in our homes because Epson has just released a rather nice AT compatible, the PC AX. The machine runs an 80286 processor at switch selectable speeds of 6, 8 or 10 MHz and comes with 640k of RAM as standard.

The AX features a small desktop footprint and new style IBM standard keyboard layout. Disk storage options are 20 and 40Mb hard disks. Interestingly, the brochure for the PC AX features a very worried looking man sitting in front of the machine (in the typical 'happy user' pose) with a pale face apparently in a cold sweat!

Mobile radio terminal

The Sacramento Police force use this, and it looks like a great idea to me. Instead of pagers and one line message beepers, mobile servicemen and business people can install one of these radio terminals in the car.

Messages are displayed on a 40 x 8 LCD display, and may be browsed. Messages received when the vehicle is unattended are stored within the terminal, and all transmissions are encrypted. Full logging can be performed to provide traffic and response statistics.

Apparently the Victorian and Tasmanian Police force are interested, and no doubt a few courier, taxi and support organisations will be too. The Kustom MCT-30 is imported by Heden-Spike, who may be contacted through their PR people on (02) 29 3351.

Software

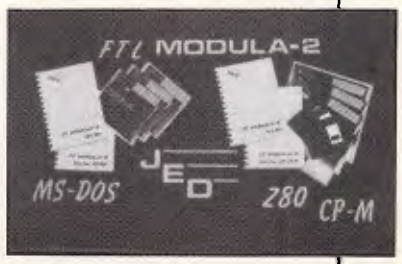
Turbo Pascal for the Mac

Borland International has announced a version of the immensely popular Turbo Pascal for the Macintosh. Not yet available in Australia, the compiler makes full use of windows and mouse control, allowing edit, compilation and execution in multiple windows.

Turbo on the Mac is said to compile at a speed of 12,000 lines per minute, which is about ten times faster than on PC machines. Large program development is aided through the Unit Structure feature, which allows the linking of small programs to form a single unit.

Turbo Pascal is not copy protected, requires 256k of RAM and a 400k disk drive. In the US, it currently sells for $US99.95.

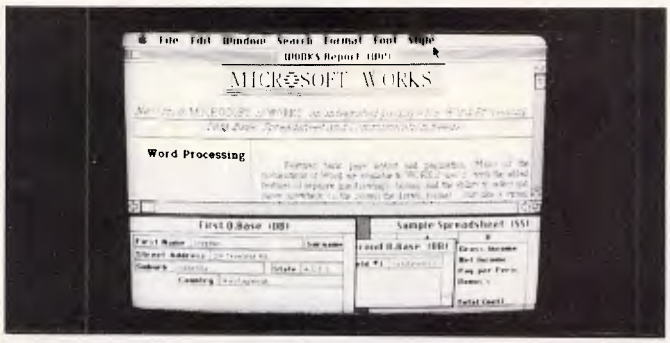
Aussie Modula-2 compiler



The Australian FTL Modula-2 compiler produced by Cerenkof Computing in Queensland is now available in Melbourne through JED Microprocessors.

If FTL Modula-2 sounds like a familiar name, it's probably because you've been seeing it reviewed in US magazines, where it has been achieving a good degree of success. The compiler is a complete development environment including a full screen editor, windows, keyboard enhancement and macros. Alternatively, a compilation may be performed "from the command line". One megabyte of source code is provided for many of the utilities included with the compiler (LIST, XREF, COMPARE, SORT, GREP and several more).

The FTL compiler includes several extensions to the Niklaus Wirth standard and, best of all, costs just $100. Versions are available for MS-DOS and CP/M based machines. For more information, call JED on (03) 762 3588.



New from Microsoft

Version 4.0 of the Microsoft C compiler now more closely matches the ANSI standard for the language and includes the CodeView window-based symbolic debugger. CodeView features pull down menus, mousing, source code display and much more. The new release of the compiler features enhanced optimisation and a library of 200 run-time routines. Both the library and source code is compatible with 286 Xenix C. Additionally, two extra memory models have been

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Datapoint 3601, 8220*	User Defined

Digital Equipment VT52, VT102, VT220
Hazeltine 1400, 1410, 1500, 1520
Hewlett Packard 2622A, 2624B*
Honeywell VIP 7205, 7801, 7803, 7813*
IBM 3101 Model 10 and 20, 3161*
Lear Siegler ADM-2, ADM-3A, ADM-5
*Coming Soon

Softerm is also available in versions for the NEC APC III, Tandy 1000/1200, Wang PC, TI Professional, DG1, Gridcase and Apple IIe & IIc, MacIntosh version coming soon.

New Release 1986

Additional protocols available in the 2Q86 release of Softerm PC will include KERMIT (the public domain protocol developed at Columbia University), Hayes Verification Protocol (Smartcom), and CLINK (Crosstalk).

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provided.

The compiler costs $925; upgrades are either $125, or free to recent buyers. Owners of Lattice of IBM C may upgrade for $250. For interested parties, a demo disk of CodeView is available.

Also new is a drawing package for Windows, called DRAW! Everyone knows that one of the most successful uses of mice and windows is in free-hand doodling, and this new bundle of fun will soon be available for $395.

For the Mac, Microsoft Works is an integrated application environment similar to AppleWorks, providing word processing, database, spreadsheet, graphics and communications. It is expected to sell for $595.

Microsoft is on (02) 452 5088.

New Turbo Prolog release

Again from Borland International, a new release of Turbo Prolog has been announced and is available in Australia. Turbo Prolog 1.1 offers increased support for large applications including a three fold increase in compilation speed, an internal linker and decreased memory requirements.

The ability to automatically recompile all programs associated with a particular project is provided, as are window hot keys. Over 100 commented programs are supplied on the tutorial disk, including a sentence analyser and symbolic differentiator.

It is currently unknown whether Turbo's inability to dynamically modify its rule base has been addressed in the new release, but with over 45,000 copies sold in six months, it is clear that the product is continuing to move forward.

Upgrades are being offered free of charge and more information is available from Arcom Pacific on (07) 52 9522.

Low cost CAD

Many potential CAD users are turned off by the price of the software and hardware, thinking that computers cost just a couple of thousand dollars. To address this, Comprador Business Systems has configured a low cost entry level CAD configuration aimed at first time users.

Based on AutoCAD, the ProStarter-1 package includes an IBM PC/XT, AutoCAD 2.5, a digitiser and plotter. The price reduction has been achieved by avoiding the use of an AT machine and by 'unbundling' training and support. Depending upon configuration details, a full CAD system could be delivered from between $15,000 and $20,000.

Since this package is aimed at first time users, delivering low power hardware and skimping on training and support may not seem like such a good idea. Users get one day of training and 7 days of phone support, after which they must pay for any assistance.

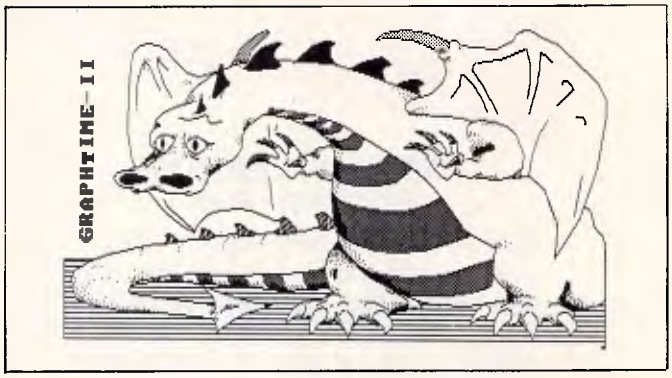
I guess the whole thing is a marketing concept, and one which doesn't do any favors for the first time user. Experienced users know that if you want to skimp on the cost of computerising, it just doesn't pay to skimp on training and support. If *you* want to learn that lesson, call Comprador on (02) 681 4000.

To Bee or not to Bee

Microbee has released a new WYSIWYG word processor for its Premium Series of personal computers. Named "Simply Write", and described as "super friendly", the processor provides both control key and pull down menu access to editing functions. Three styles of page formatting are provided, and a Zoom facility draws a graphic representation of the page layout. On-screen bolding, underlining, italics and font control are included, with the ability to customise fonts using a font editor.

Predefined support for Brother, NEC and MicroBee printers is included, and other printers may be handled by setting escape codes. The software is, of course, entirely produced in Australia and sells for just $69.50, believe it or not, *including* sales tax.

More information is available from Microbee on (02) 886 4444.



Graphtime-II enhancements

An Aussie graphics system, Graphtime-II, has been enhanced to run in only 256k of memory and now includes a text/graphics editor. User input may be through the keyboard, mouse or joystick. Lotus-like macros and animation are also included. Printers now include C Itoh, Prism, Tandy, Quadram, IBM Inkjet, NEC and Okimate-20. The package will also happily print or plot on anything capable of digesting HP-GL (Hewlett Packard Graphics Language).

Graphtime-II now costs $135, including sales tax, which is very competitive. More information is available from Computer Performance on (09) 299 6153.

IBM moves to Viatel

In recognition of the growing success of Telecom's Viatel videotex system, IBM has moved to place a software catalogue and dealer list on the service.

Viatel recently announced it had reached 20,000 subscribers, and is likely to be at the 25,000 mark by the time you read this, with Viatel scurrying to upgrade its hardware to support the increased user load. Some 75% of Viatel users access the service through microcomputers of some sort, and IBM expects users to quickly recognise the convenience of on-line catalogue buying.

More information is available from IBM on Viatel (IBM doesn't give the page number), or by calling (02) 634 8699.

Macintosh Glue

SCA has obtained distribution rights for a product called Macintosh Glue. It allows users of applications such as MacWrite and Word to 'print to disk', upon which the data may be included in other desktop publishing software. Alternatively, the data may be transmitted electronically.

For a machine environment in which everything is supposed to talk to everything else, it is a sad day when third party products are required to assist the cause.

If you're into desktop publishing, SCA is on (03) 699 7255.

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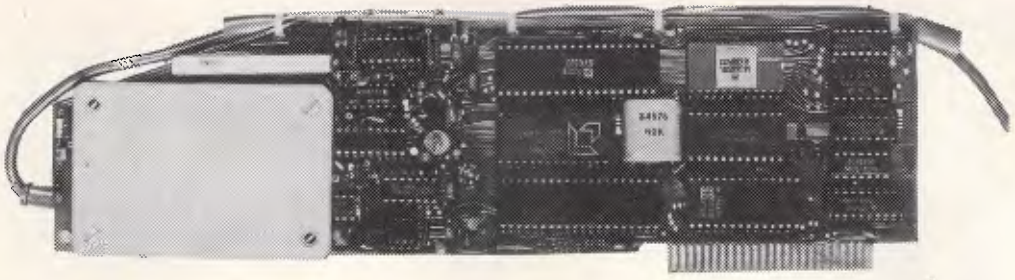

* Super intelligent direct connect MODEM/VIATEL terminal for APPLE II, IIE & compatibles fully contained on a single card — plugs into slot#2 — does not require separate serial card or software. All software is permanently resident in an onboard 128K EPROM. It is hidden in the slot#2 card space, leaving the whole of memory completely free for other programs unlike disk based comms software which must occupy the main memory excluding other programs. It is menu driven and automatically senses for ProDos or DOS 3.3 operation. Received files are appropriately converted before saving and can be used.

Sending/receiving files is very simple:—
— Press "ESC" to display menu.
— Select "(S) END A FILE" option
— Answer the prompt "FILENAME?:"

The modem will search the disk for the file, make all the decisions (e.g. binary, basic, textfile, DOS 3.3 or ProDos) and transmit it in the correct format. <CR> transmits the file in memory. Similarly to receive a file select "(R) ECEIVE A FILE" option.

* AUTO ANSWER — AUTO DIAL. Senses true dial tone, ring tone, busy tone and acts intelligently, returning status messages. Characters can be included in the phone number to set baudrate, pause, "await dialtone" and multiple redial on busy. On answer, it selects the incoming baudrate by precision frequency measurement. This is much more reliable than the normal autosearch using carrier detect which is often confused by voice and phone tones. A reliable autosearch is a must for bulletin board operation.

* 300 Baud full duplex or 1200/75 and 75/1200 with fast automatic line turnaround. An upgrade kit to add V22 (1200/1200 baud) and V22 Bis (2400/2400 baud) will be available later.

*Main menu option "(V)IDEOTEXT" shows the VIATEL menu. It becomes a full graphics VIATEL terminal, automatically dialling and transmitting the user ID stored in the battery backed ram. When online, a keypress will immediately save pictures to memory. These can be reviewed later and selectively saved to disk or printed (requires a graphics printer card). Pictures can be loaded from disk and printed out. The modem can act as a videotext host and can be programmed to act on frame information. e.g. — use the clock to ring "MONEYWATCH" hurly and dial you at the office if your shares move outside a given range.

* TELESOFTWARE DOWNLOAD facility to purchase programs over VIATEL from suppliers such as MICROTEX 666 and TANGO.

* A full wordprocessor in EPROM for pre-composition of text before transmission. It can also be used to edit or print received files as well as for general wordprocessing.

* Onboard battery backed calendar clock can time and initiate calls or keep an activity log. ProDos uses it to time and date disk files and it is accessible from Basic.

* 2Kx8 battery powered CMOS RAM stores default parameters, phone numbers, ID, password, logon strings, search codes and setup parameters (e.g. baud rate, parity, printer ON) for each number, allowing single keystroke call establishment to specific areas of complex databases. Main menu option "(T)ELELIST" displays the list of 23 names and one is selected.

* Incorporates XON/XOFF and CHRISTENSEN error correcting protocol. Textfiles are not so fussy but error correction is a must when transferring program files. A debug function can display normally invisible control characters sent by the host.

* Can output directly to printer even when online at 1200 Baud — a fast printer is not required as the printer is spooled out of the receive buffer. A "FILTER" function is available to remove screen control characters from textfiles (these can drive a printer crazy). Special scroll routines print to 80 column screen and printer at 1200 Baud without any lost characters.

* Unique "PHANTOM MODEM MODE" function allows the modem to be permanently connected with the normal phone. When answering, if it doesn't immediately detect a calling modem it generates ringing tone back to the calling party and sounds the APPLE bell, giving you 60 seconds to answer the phone.

* If you have previously purchased this modem and have not yet received an updated EPROM VERSION V2.18 and a manual, contact AUTOMATIC ICE CO. — there is no charge for these.

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Access Custom Menu Kit SOS $56
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APL/Plus PC SOW$1212
APL/Spreadsheet Manager SOW $377
APL/Stats Set(Stat. library routine) SOW $399
Art Gallery 1/Unison Imc Ine $63
Art Studio/Spectrum Holobyte Ine $72
ASCII Express/United Software Ine $307
AST Netbios - LAN application SOW $284
Assembler Plus Tools PCDOS ARP $277
Asset Manager/Pink MSDOS BUW $799
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Back to Basics/Peachtree Ine $522
Bank St Writer IBMJX IMA $101
Basic Building Blocks/Meca Ine $75
Basic Compiler CP/M SOS $498
Basic Compiler (Business)MSDOS SOS $723
Basic Compiler MS DOS PC DOS SOS $621
Basic Concepts PCE $164
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Clip Art Vol 1 (for Newsroom) Ine $46
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Medical system

ODC has released a Medical Accounting package called Practice. The software claims to improve waiting room efficiency through effective control of billing and receipting. It even provides the ability to bill third parties, such as Vet affairs, Medicare or insurance companies.

The software is written in Dataflex, and runs in any Dataflex environment. More information is available from ODC on (02) 816 2688.

Monster game just won't stop

The Viatel-based Great Galactic Conflict, thought to be the largest simultaneous multi-player strategy game in the world, seems to be going from strength to strength.

The first game, being some three months in duration, should just be finishing as the issue goes to press. Despite one or two technical problems which have caused the bi-weekly results to be delayed by a couple of hours, the players generally seem to be in rhapsody over the game. A number have raised complaints over the high Telecom access charges, but leading players have pointed out that they manage to spend only a couple of dollars per week in online time. Many players found themselves connected far longer than they intended purely because of the advanced videotex technology employed in the GGC.

As the mortality rate has been high in certain sectors, Microtex 666 has already started organising GGC-II. This game, due to start soon in the new year with registrations closing before Christmas, is already filling up quickly.

More information is available from Microtex 666 on (03) 419 0666, or on Viatel page *666#.

Peripherals

SAM modem

Pulsar Electronics has released possibly one of the nicest multifunction modems yet to hit the market.

The SAM modem supports the V21/V22/V23 standards, so handling most requirements. These standards, in English, are 300 bps, 1200 bps and 1200/75 bps full duplex. It features automatic dialling and answering, error reset, automatic speed detection, baud rate conversion and special security features.

The modem is external, meaning easy viewing of the all important indicator LEDs, no power consumption problems, and easy interfacing to all types of computer. The unit has been extensively field tested, involving some 1000 test sites and 90 ROM revisions. It is Hayes SmartModem compatible, as well as providing several useful extensions, such as the modem's ability to generate command menus and help information. A built-in dial-back security system is included for almost 100% foolproof integrity.

A normal telephone can be piggy-backed off the modem, and both the telephone and modem can be used normally in this configuration. Priced at $862, Pulsar is currently pushing these units out the door as fast as they can. Little wonder, too.

Pulsar is on (03) 330 2555.

Canon quiet printer

The Hong Kong Stock Exchange has become one of the largest printer installations in the world due to its acquisition of 800 Cannon PW 1080A printers. This printer was chosen for its quiet operation at high print speeds, performing 160 cps at a mere 60 dB.

With this printing capacity, the stock exchange can print about 7,600 pages per minute.

A Canon LBP8AI laser printer is being used in Australia to produce personalised children's books. Each book is customised using the child's name, best friend, pet, birth date and address. Using the printer, a 32 page book can be produced in just two minutes.

More information is available from Canon on (03) 200 6200, or from Star Lazer Books on (02) 692 1788.

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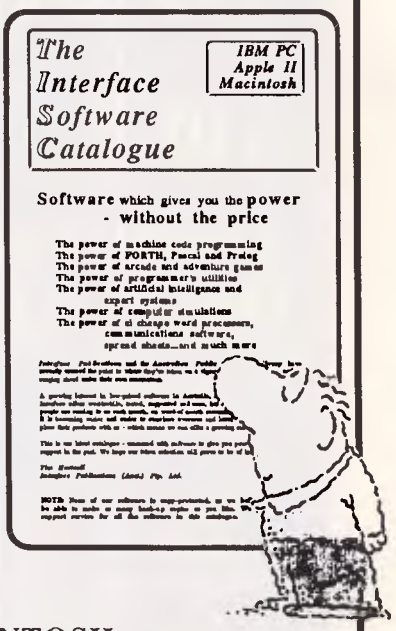

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WHAT'S NEW

MegaModem

The modem stakes hot up as Avtek enters the market with its MegaModem. This external device is Hayes compatible with automatic baud rate detection, command menus, autodial and answer.

The modem supports the V21, V22 and V23 protocols, and costs just $499 including tax. More information is available from Avtek on (02) 427 6688.

Arcom data comms

Arcom Pacific has entered the data communications race by being appointed as the exclusive distributor for the Scitec range of communications products.

Included in the range is the Olympic 300, 1200, 1200/75 and 2400 bps modem, the Hayes compatible Tristar modem with 300, 1200 and 1200/75 capability and the 2123 videotex modem which is capable of 300, 1200/75 and 300 bps half duplex.

Arcom is also distributing the Cybersoft Gateway videotex software. A release of this software examined a few months ago could do everything exceptionally well, unless you happen to want to transmit keystrokes to the videotex system. Keystrokes had to be made very slowly and carefully, with the screen often becoming corrupted. If you're interested in this software, it could be worthwhile ensuring that Cybersoft has rewritten the communications handling recently. Great logo, terrific screens, just weak on communications.

Arcom Pacific is on (07) 52 9522.

Power protection

Tranzorb has announced the release of the Powerbank 500 standby power supply. This power unit, designed and manufactured in Australia, can deliver 240v AC power at 2 Amps for 15 mintues at full load. At a 1 Amp load, the power can hold out as much as 30 minutes.

The device features fast switchover time, sealed maintenance-free lead acid battery, surge and lightning protection and a LED status display.

More information is available on (02) 637 7155.

Apple 20Mb disk

Apple Australia has announced the availability of the new Apple SCSI Hard Disk 20, which offers high speed operation to both Macintosh Plus and Apple II users. Additional devices can be daisy chained through the SCSI (Small Computer Standard Interface) port.

Costing $3,495 including tax, the SCSI HD-20 costs around $250 more than the existing HD-20, but Apple expects the new disk to grab most of the sales over the next twelve months.

Apple Australia is on (02) 888 5888.

Epson 2500 printer

It's true. I always wanted an Epson LQ-1500 printer. Just the thought of one seemed like printer heaven. Who could have asked for more — ultra fast draft mode and an elegant 80 cps letter quality mode?

Well, it's time to update one's fantasies. Epson has just released the LQ-2500. This gorgeous device features a 24 pin print head, LCD control panel, 324 cps draft mode, 108 cps letter quality mode and an 8k buffer. Four control buttons and the 20 character LCD prom-

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pts and confirms print modes, and up to four standard printer configurations may be stored into the unit for recall. Five standard fonts are provided.

The LQ-2500 is priced at around $2,150, and I know what I want for Christmas. Epson is on (02) 452 5222.

Overseas

AT&T parallel processor

AT&T has been awarded a DARPA (Defence Advanced Research Projects Agency) contract to develop a prototype of a pattern matching computer.

The machine is required to recognise speech and images, and to do it in real time. The contract is worth around $7.7 million, and is part of the SCI (Strategic Computing Initiative), although its application to SDI (star wars) is obvious.

AT&T is subcontracting portions of the project to the smaller Fifth Generation Computer Corporation in New York, said to have a viable parallel processor architecture called Dado. The project is expected to run for about three years.

Neural networks

Simulating the brain through electronic neural networks (ENNs) is becoming common place. Researchers at Bell Labs have studied the neural makeup of slugs and, from this, started designing elementary neural chips.

So far, they have succeeded in creating a 22 neuron device with 22 input channels. More recently, a 54 neuron chip has been fabricated. Although the number of neurons is rather low, the chips provide the same high degree of connectivity found in the human brain, with 54 neurons producing about 3000 synapses (intersections).

Learning takes place in the synapses through the use of programmable resistors to establish thresholds, just as in the human nervous system.

Work is currently proceeding on 256 and 512 neuron chips, although the 54 neuron chip has successfully been used to match similar names in a list. It is expected that ENN chips will be able to perform pattern matching tasks around 100 to 1000 times faster than existing technology, due to the inherent parallelism.

CGA and EGA doomed

Rumour from IBM is that not only will the company terminate its CGA display adaptor, but that the EGA is also destined for nowhere.

This rumour comes as quite a surprise at a time when large numbers of vendors scramble to supply EGA compatible adaptors and users spend several thousand dollars upgrading to the EGA standard.

WHAT'S NEW

Its replacement, the EGA Plus, will be the final link in the once mythical '3M machine' (1 MIP, 1 Megabyte, 1 Million Pixels). The EGA Plus is predicted to provide 1024 by 1024 graphics resolution, but is not expected to be released within the next twelve months.

New IBM DOS

Within six months, IBM will release an advanced operating system for 80286 and 80386 based computers called ADOS.

While details are sketchy at the moment, the new DOS will provide multitasking, scheduling and virtual memory, maintaining compatibility with PC-DOS 2.x and 3.x applications. ADOS is said to have been developed independently of Microsoft, yet its features broadly correspond to those expected in MS-DOS release 5.

Internally, the ADOS architecture is hauntingly reminiscent of the fun and games normally seen in system 370 operating systems. The DOS is complex and multi-faceted.

If ADOS *is* different from DOS 5, the PC world will have another operating system battle on its hands. It seems skipping the 80286 and shifting directly and wholeheartedly to the 80386 would produce a simpler, more efficient operating environment.

IBM has been known to can major products on the eve of their release, so there is no guarantee that ADOS will actually see the light of day. The final shape of MS-DOS 5 may have a great influence over the final decision.

END

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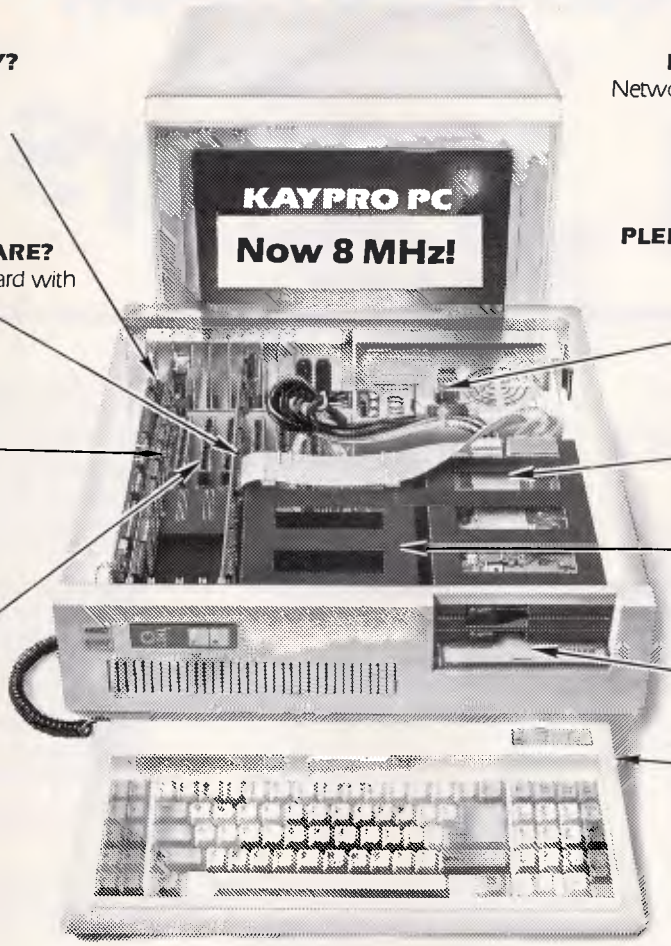

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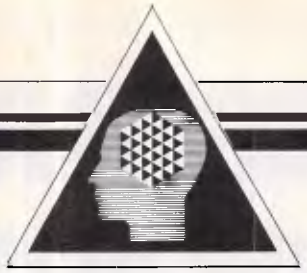

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Michael Brady, University of Oxford, England

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Bob Kowalski and Frank Kriwaczek, Imperial College, London

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Donald Michie, Turing Institute, Glasgow, and Ivan Bratko, Joseph Stephan Institute, Yugoslavia

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If you fancy programming your Mac in Logo, a suitable guide exists. Or how about an introduction to expert systems? David Taylor reviews this month's reading matter.

Parlez-vous Algol?

Michel Gondran is another one who's no Jeffrey Archer. This slim little teaser is translated from the French, although when Michel really gets going it's sometimes hard to see why they bothered. I find, *zut alors,* that this typical example means as much to me either way:

```
IF Diagnosis(t) = primary breach
   Vanne Dech pressure or asp
   norm(t) = wide open
   P surrounded(t) = normal
THEN Diagnosis(t) --- Press rap
        primary Circuit by pressure
        Procedure(t) --- AB
```

But then I'm no doctor, nor an expert in SNARK. You'd need to be both to make head or tail of that bit, and it'd help to be a bi-lingual mind-reader if you're following fast-thinking Michel when he gets cracking on metaknowledge and structures of inference engines in Pseudo-Algol.

This claims to be an *introduction* to Expert Systems. *Ptfui*! It is incomprehensible to anyone who is not already an expert in Expert Systems.

Title: An Introduction to Expert Systems
Author: Michel Gondran
Publisher: McGraw-Hill
Price: $22.95

Mac turtle soup

Nobody knows why, but the left side of your brain is pretty smart at reasoning and handy with words, but the right side of your brain is the arty part—recognises patterns and shapes, knows a good tune when it hears one via your ears.

It's almost as if you had an IBM PC on the nearside and an Apple Mac on the offside of your head. Both halves, or both machines, are good at what they do; it's just that they set about their tasks in different ways.

Messrs Haigh and Radford are dedicated MacMen. Nothing at the price to touch Macs for zappy patterns or visualising things, they insist. So why stop at using the boxes full of ready made applications when the Mac is itching to be programmed, if only there were a language which could take advantage of its arty-graphical bent?

Like turtle-mad Logo.

Well, the short answer is that it's a time-consuming bore to tell Macs what to do in Logo, when you could just point the mouse and go in any one of dozens of off-the-shelf programs. The plain fact is that the Mac is so user-friendly and all kinds of purposes are so well-served by excellent packages like Jazz or, for that matter, plain old MacWrite and MacPaint, that it seems perverse to write programs to tell a turtle to draw shapes which could fall to hand much more easily.

Now, of course, there's something to be said for the skill of programming *per se,* just as there's something to be said for knowing how a car works as well as just knowing how to drive it. But the Mac is the kind of machine which encourages users to get on with it, do something useful and *quickly,* without the need to play

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and enter my name in the PC DRAW. Enclosed please find cheque/ purchase order/ money order/ Bankcard/ VISA/ MasterCard

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around with gobbledy-gook programming languages.

Well. Decide for yourself whether you're a MacUser who's predisposed to program. If so, then you could do a lot worse than start with Logo, which is by no means the kids' stuff it's often made out to be. Microsoft does a first-rate Logo package for the Mac — and the company also provides a fat manual of reference and a *Guide to Programming* besides. So do you need this book as well?

I rather doubt it myself, unless you're hell-bent on doing things the hard way because it's good for the soul or for your knowledge of what goes on under the computer's bonnet. Of its kind, *Macintosh Logo* is an efficient textbook but the rewards of mastering Logo aren't necessarily up to much — after 200 pages you're still finding out how to analyse your electricity bill or draw some polygons.

Terrific, provided you think that sounds fun. Myself, I'd rather fiddle about with *Music Works* any day and Messrs Mac, of course, would rather you cashed in your savings for a laser printer and set up shop as a desktop publisher.

It takes all sorts.

Title: Macintosh Logo
Authors: Roger W Haigh
& Loren E Radford
Publisher: Wiley Press
Price: $41.70

Ten megabytes' hard labour

Let's split everyone up. Hands up, to begin, all those who were weaned on computers which only responded to gibberish. Right, you lot can stay for the moment. The others can push off and count themselves lucky they were brought up on a Mac.

Let's now separate out those who *like* talking gibberish to computers. That means anyone who can program, anyone who is well-practised in a computer language, even if it's only Basic. Off you go, you lot, and do some hacking or whatever it is that you do.

Now for the final sort-out. If it has not yet occurred to you that there is something fundamentally ludicrous, not to say inhuman, about mastering disk-operating systems like the ubiquitous MS-DOS, you'd best be on your way.

There are people, I know, who find nothing especially unsettling about typing-in lines like:

COPY A:/BLETHER/SCRIBBLE.BAK C:/TWADDLE/BUNKUM.DOC

Just as there are those who seem to have no difficulty learning Serbo-Croat, or perhaps even Double Dutch. Odd, you might think, but there it is.

Right, then. By now we should have isolated only those people for whom (a) using a computer is a professional must; (b) the use of an IBM PC or similar is also a must, because everybody else seems to have one; and (c) using ready-to-run applications is the only sensible way to operate.

For them, PC-DOS can be a pain in the motherboard.

There are, I dare say, several million sufferers. They have read, or at any rate skimmed, the fat pink manual which came with the machine, but found they *could* put it down. The khaki one, labelled Basic, they only use as a doorstep.

These people have tried, good grief they have tried, to come to terms with DOS. They've toyed with buying GEM. They have contemplated calling it a day and switching to a matier Mac. They live in fear of being networked.

Often they've just about got the hang of 'dossing down' with a twin-floppy system, then been tempted by a hard disk (so cheap now and much handier, the man said).

Partitioning, eh? Tree-structured directories? Or using BACKUP and RESTORE? With tears in their eyes, they remember the bad old days of grappling with — saints preserve us — EDLIN.

The fifth cavalry doesn't come cheap ($39.95 for only a couple of hundred pages) but the Cains are very able at fog dispersal and have turned out a lucid summary of minimal DOS for the hard-pressed, rather than for enthusiasts.

They hold hands through the organisation and protection of files on an XT or AT, frighten the life out of you ('All hard disks fail eventually') and then suggest a few sensible working methods for keeping everything tickety-boo and free from the risk of sudden calamity.

It's nothing special if you're really familiar with DOS, but it could be very useful if you're not, and should be.

Title: Hard Disk Management
(for IBM PC XT, AT)
Authors: Thomas Cain/
Nancy Woodard Cain
Publisher: Prentice Hall
Price: $39.95

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RIBBON FOR 1201-1000	= $22.74

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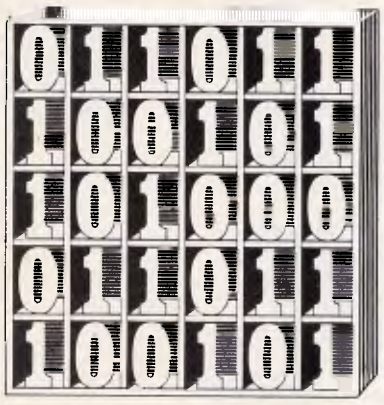

David Barrow presents more documented machine code routines and useful information for the assembly language programmer. If you have a good routine, an improvement or conversion of one already printed, or just a helpful programming hint, then send it in and share it with other programmers. Subroutines for any of the popular processors and computers are welcome but please include full documentation. All published code will be paid for. Send your contributions to Subset, APC, 2nd Floor, 215 Clarence Street, Sydney 2000

8086 INTELLIGENT BLOCK TRANSFER

The first datasheet this month illustrates the pitfalls of attempting to convert a tried and tested routine from one language to another without taking into account the major conceptual differences between the languages.

IBT8086 from Steve Hunt is a straight translation of the Z80 block transfer IBTZ8 (*APC,* October 1984). The program structure of datasheet 1 is identical to that given for IBTZ8 and Steve has encoded this metalanguage in the nearest 8086 equivalent to the original Z80 code. If identical conditions obtain, then IBT8086 will work exactly as IBTZ8.

Since the Z80 is essentially an 8080 with 16-bit frills and the 8086 is an 8080 redesigned to cope with larger memory and 16-bit operations, line by line conversion between the two languages would seem not only possible but the normal method of implementing existing software on the more advanced machine. Indeed, such straightforward conversion will often work correctly where the 8086 system is designed specifically to emulate the Z80 or 8080 and is limited to 64k memory. However, the 8086's unusual method of addressing larger memory in 64k segments is a complicating factor which makes simple conversion difficult in more fully utilised 8086 systems.

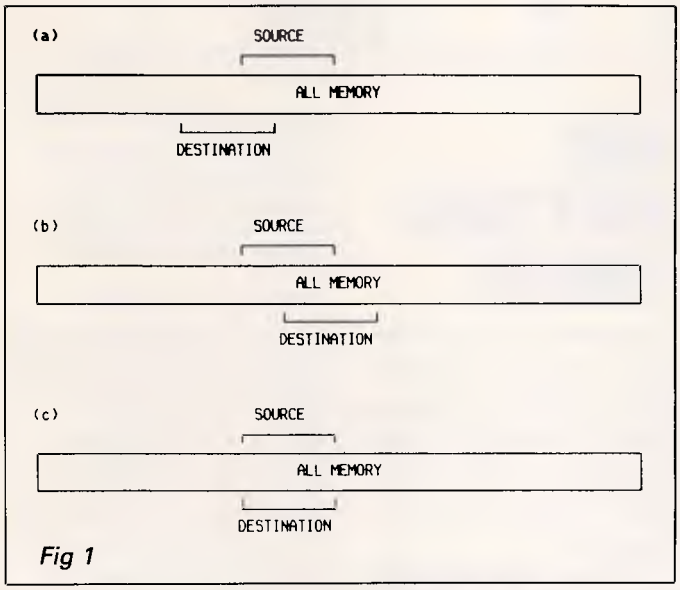

Fig 1

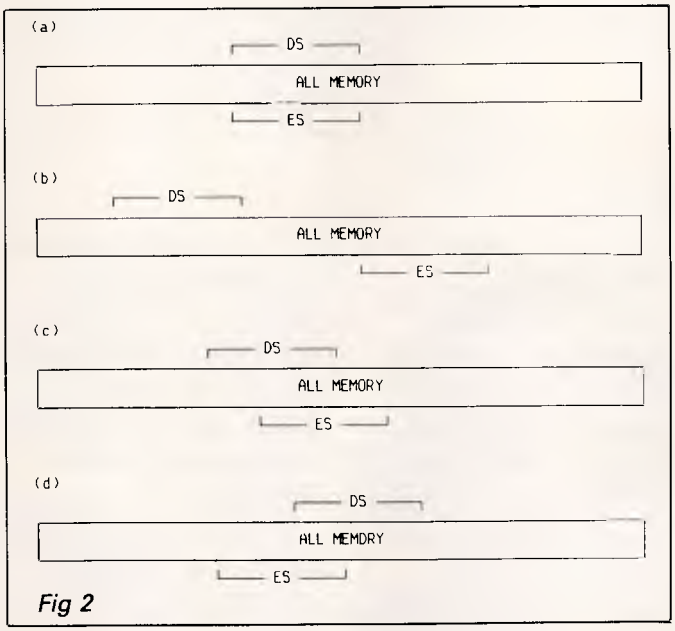

Fig 2

Fig 1 applies generally to all processors and languages and shows why the transfer of a block of data within memory cannot be done simply by starting at the lowest address and working through to the highest where source and destination areas may overlap. In case (a) no problems occur, but in case (b), where the source is lower in memory than the destination, the source data in the overlap area will have been overwritten by copied data before it is moved. The problem is eliminated in this case by reversing the process and beginning the transfer at the higher address.

Case (c) of Fig 1, where source and destination pointers are equal, would seem to not require any transfer at all. It is possible, however, that the system utilises bank switching where read and write instructions each access different memory banks residing at the same addresses. If this is so, then the transfer routine must perform the move since the equality of source and destination is only apparent and not actual.

Fig 2 applies only to the segmented addressing of the 8086. In case (a) the DS and ES registers, used as source and destination segment registers repectively, each address the same 64k block of memory residing at a 16-byte boundary. In this case only, 8086 addressing corresponds to that of other processors and the direction of transfer can be calculated by comparison of the source and destination pointers, SI and DI. However, cases (b), (c) and (d) of Fig 2 each pre-

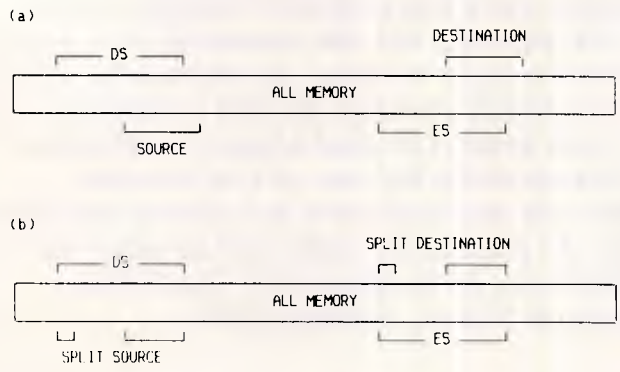

Fig 3

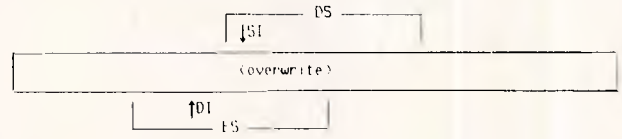

Fig 4

sent problems.

In case (b) of Fig 2, the source and destination *segments* are entirely distinct and have no overlapping area. This has two important consequences. The first is that if the source and destination *pointers,* SI and DI, are equal, then two completely separate areas of absolute memory are referred to and the transfer should take place. IBT8086 fails to take this into account.

The second consequence shown in Fig 3, is that memory wraparound occurring within each segment will split the source and destination blocks, locating them at high and low order ends of the respective segments. This results in the transfer of two smaller blocks of memory (Fig 3(b)) rather than an intended single large block extending past the segment boundary (Fig 3(a)).

In cases (c) and (d) of Fig 2, the source and destination *segments* overlap. In both cases comparison of only the source and destination *pointers* without adjustment for the segment locations gives no indication of the relative positions of the two areas in absolute memory terms.

Fig 4 shows one possible case where segment overlap would cause IBT8086 to take the wrong action. The source pointer SI has a lower value than the destination pointer DI.

IBT8086 understands this to mean that the source data resides in lower memory than the destination area and consequently performs the transfer beginning at the highest source location. Yet, because the destination segment ES is lower than the source segment DS, the source is actually in higher memory. The result is an overwrite of that part of the source data between SI and the end of the destination segment before it has been transferred.

DATASHEET 1

```
;
;CALL: IBT8086      Non-overwrite data block move within memory.
;
;CONCEPT            (System & language independent description)
;Prog. Structure    IF source = destination
;                   [
;                   ;
;                     IF source below destination
;                     [
;                       Set pointers to last bytes.
;                       FOR last byte to 1st byte
;                       {
;                         (destination) = (source).
;                         decrement pointers.
;                       }
;                     ;
;                       Set pointers to 1st bytes.
;                       FOR 1st byte to last byte
;                       {
;                         (destination) = (source).
;                         increment pointers.
;                       }
;                     ]
;                   ]
;-------------------------------------------------------------------
;SYSTEM             (System implementation requirements)
;Processor          8086/8088
;Hardware need      RAM for transfer source & destination.
;Software need      None.
;-------------------------------------------------------------------
;PROGRAM            (Specific coding and operation details)
;Input state        DS:SI addresses source block first byte.
;                   ES:DI addresses destination block first byte.
;                   CX = number of bytes to transfer.
;Output state       If input SI=DI then no move.
;                       Flags changed. No other changes.
;                   Block at DS:SI copied to ES:DI. CX = 0.
;                       If input SI<DI then
;                         D flag = 0, SI & DI at last bytes + 1.
;                       If input SI>DI then
;                         D flag = 1, SI & DI at first bytes - 1.
;Misuse Errors      Segment (64K) wraparound and the comparitive positions
;                   of the DS & ES segment registers could cause overwrite
;                   before transfer.
;Register need      DS ES SI DI CX F
;Location need      Correct working can be guaranteed only if DS=ES.
;                   Routine is not location dependent but must be called
;                   from within the same Code Segment.
;Program Bytes      21
;Stack Bytes        None.
;Clock Cycles       (8086) SI<DI: 72+17*CX.  SI=DI: 23.  SI>DI: 32+17*CX.
;-------------------------------------------------------------------
;SUBSET CLASS       (Environmental hazard guide)
;-****-   2         Discreet:  NO     Interruptable: YES    Promable: YES
;                   Reentrant: YES    Relocatable:   YES    Robust:   NO
;-------------------------------------------------------------------
;
IBT8086 CMP   SI,DI         ;If source is not equal    3BF7
        JNE   FORWARD       ;to dest then continue,    75  0I
        RET                 ;Else exit, no move.       C3
;
FORWARD JB    BACKWARD      ;If source above dest then 72  04
        CLD                 ;set auto-inc and          FC
        REP                 ;for count CX transfer     F3
        MOVSB               ;DS:SI to ES:DI.           A4
        RET                 ;Exit, move made.          C3
;
BACKWARD ADD  SI,CX         ;Source below dest so set  03FI
        DEC   SI            ;source & dest pointers    4E
        ADD   DI,CX         ;to last bytes for reverse 03F9
        DEC   DI            ;transfer.                 4F
        STD                 ;set auto-dec and          FD
        REP                 ;for count CX transfer     F3
        MOVSB               ;DS:SI to ES:DI.           A4
        RET                 ;Exit, move made.          C3
;
```

6502 ROTATIONS TOOLKIT

Datasheet 2 from Andrew Johnson, contains a set of three toolkit routines to emulate the Z80's arithmetic right shift and 8-bit rotation with copy to Carry. These useful operations are lacking from the 6502's meagre repertoire.

Andrew points out that at only four bytes each (excluding the RTS), the routines would probably be more effective as in-line code sequences (macro instructions) unless called often.

68000 Interruptibility

Roger Thomas, writer of last month's character rotation routine, points out that 68000 systems may interrupt user mode programs without reference to the user stack. Hence programs which move the user stack point above stacked data *may* be interruptible.

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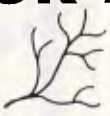

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Bold	YES	NO	NO
Auxiliary Characters	YES	NO	NO
Horizontal Scrolling	YES	NO	NO
Split Screen Viewing	YES	NO	NO
Multiple Documents in Memory	YES	YES	NO
Column Copy/Move/Wipe	YES	NO	NO
Column Alignment	YES	NO	NO
Max size of Document in 128k Apple //	52k**	55k	30k
User Definable keys	YES	NO	YES
Word Search:			
Bounded	YES	NO	NO
Bi-directional	YES	NO	NO
Wildcard	YES	NO	NO
Form Letters	YES	NO	YES
Label Printing	YES	NO	NO
List Management:			
Mail	YES	NO	YES
Reference	YES	NO	NO
Standard Paragraphs	YES	NO	NO
Sort	YES	NO	YES***
Select	YES	NO	NO
Interactive page preview	YES	NO	NO
Hyphenation	YES	NO	NO
Footnotes	YES	NO	NO
Multi-column text	YES	NO	NO
Printing:			
Background	YES	NO	YES
Nominated Pages	YES	NO	NO
File Management:			
Automatic backup	YES	NO	NO
Encryption	YES	NO	NO
Capture Directory list	YES	NO	NO
Word Count	YES	NO	NO

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DATASHEET 2

```
;
;CALL: TLKTASR    Toolkit Arithmetic Shift Right byte.
;CALL: TLKTRLC    Toolkit Rotate Left Circular byte.
;CALL: TLKTRRC    Toolkit Rotate Right Circular byte.
;
;CONCEPT          (System & language independent description)
;Structure        save input value.
;                 copy shift/rotate in bit to Carry flag.
;                 restore input value.
;                 rotate through Carry.
;
;SYSTEM           (System implementation requirements)
;Processor        6502
;Hardware need    None.
;Software need    None.
;
;PROGRAM          (Specific coding and operation details)
;Input state      A contains the value to be shifted/rotated.
;Output state     V unchanged. N, Z reflect output A status.
;                 C = input A msb (RLC) or lsb (RRC & ASR).
;                 A = correct result ASR A, RLC A or RRC A.
;                 No other changes.
;Misuse Errors    None.
;Register need    A P
;Location need    Not specific.
;Program Bytes    15 (5 each)
;Stack Bytes      1
;Clock Cycles     17 for any one operation.
;
;SUBSET CLASS     (Environmental hazard guide)
;******   1       Discreet: YES   Interruptable: YES   Promable: YES
;                 Reentrant: YES  Relocatable:  YES   Robust:   YES
;
;
TLKTASR  PHA                ;Save original value A while      48
         ASL  A             ;getting bit 7,A into Carry.       0A
         PLA                ;Restore original value and        68
         ROR  A             ;Shift right copying sign bit.     6A
         RTS                ;Exit, ASR done.                   60
;
;
TLKTRLC  PHA                ;Save original value A while      48
         ASL  A             ;getting bit 7,A into Carry.       0A
         PLA                ;Restore original value and        68
         ROL  A             ;rotate through C effecting an     2A
         RTS                ;8-bit rotate with bit 7 to C.     60
;
;
TLKTRRC  PHA                ;Save original value A while      48
         LSR  A             ;getting bit 0,A into Carry.       4A
         PLA                ;Restore original value and        68
         ROR  A             ;rotate through C effecting an     6A
         RTS                ;8-bit rotate with bit 0 to C.     60
;
```

NETWORKS

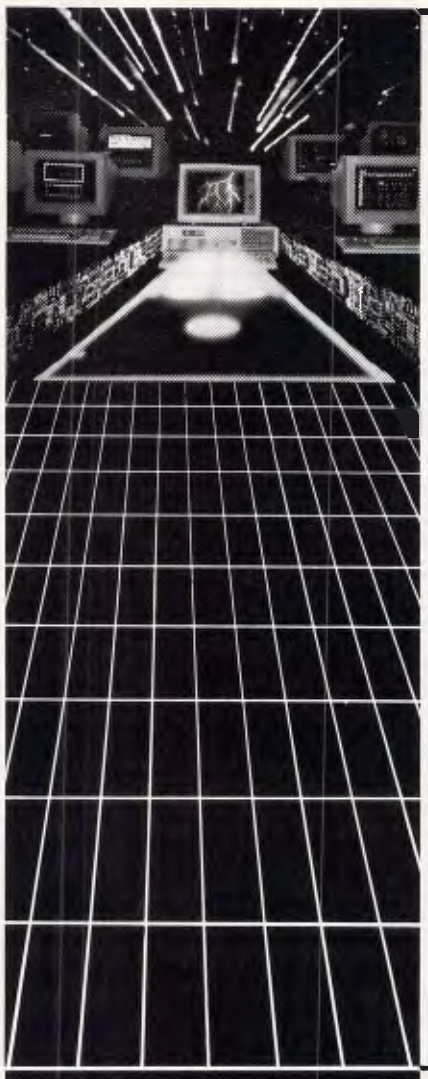
This conclusion to our three part networking feature (parts 1 and 2 were in the October and November issue of APC) is a table of some of the local area network products available in Australia. It is not intended to be comprehensive, but is an overview of the market-place.

MANUFACTURER	PRODUCT	CABLE/BAND	TOPOLOGY	ACCESS METHOD	STATIONS	GATEWAY TO MAINFRAME
3-Com	EtherSeries	coaxial/base	bus	CSMA/CD	1,024	yes
3-Com	3+	coaxial/base	bus	CSMA/CD	1,024	yes
AST Research	AST Resource Sharing Network	coaxial/base	bus	CSMA/CD	132	yes
Corvus Systems	Omninet	tp/base	bus	CSMA/CD	64	yes
Corvus Systems	Netware/O	tp/base	bus	CSMA/CD	100	no
Gateway	G-Net	coaxial/base	bus	CSMA/CD/CA	128 per server	yes
IBM	PC Network	CATV/broad	tree or bus	CSMA/CD	72	yes
IBM	Token Ring	tp/base	star wired ring	token	260	yes
IDEAssociates	IDEANet	coaxial/base	bus	CSMA/CD	20	yes
IDEAssociates	IDEAShare	RS232/base	star	proprietary	4	no
Novell	Netware/S	tp/base	star	proprietary	24	yes
Novell	Netware/G	coaxial/base	bus	CSMA/CD	128 per server (Novelle permits multiple server connection)	yes
Novell	Netware/ARCNET	coaxial/base	star string	token	128 per server (multiple server can be connected)	yes
Novell	Netware/Ethernet+	coaxial/base	bus	CSMA/CD	128 per server	yes
Orchid Technology	PC-net	coaxial/base	bus	CSMA/CD	256	yes
Quadram	Quadnet 1X	tp/base	star shaped ring	token	255	yes
Server Technology	EasyLan	RS232/broad	star	proprietary	16	no
Sytek Incorporated	Sytek 6000	coaxial/broad	tree	CSMA/CD	1,000	yes
The Software Link	LANLink	RS232	star or tree	proprietary (Netbios compatible)	16 per server	no
The Software Link	Multi-Link Advanced	RS232	star	proprietary (Netbios compatible)	8	no
Torus Systems	Tapestry	coaxial/base	bus	CSMA/CD	100	yes
Ungermann-Bass	NET/ONE	multiple options	bus or ring	CSMA/CD token	1000+	yes
Walters	D-Link	tp/base	bus	CSMA/CD	255	no
Wang	PNS	coaxial	star	token	255	yes
Wang	Wangnet	coaxial/broad	bus	CSMA/CD	unlimited	yes
Wang	Fastlan	coaxial/broad	bus	CSMA/CD	640	yes
Waterloo	Waterloo Port	coaxial/base	distributed star	token	255	yes

NETWORKS

(Note that some networks' servers can be connected together to increase the maximum permissible number of work stations. Check with suppliers where the number of work stations shown in this table is insufficient for your needs).

FILE LOCK	RECORD LOCK	FILE SECURITY	SUPPLIER	TELEPHONE	PRICE
yes	yes	yes	Imagineering	(02) 662 4499	$1716 per node (plus server software from $1500)
yes	yes	yes	Imagineering	(02) 662 4499	Depending on configuration
yes	yes	yes	Imagineering	(02) 662 4499	$2945 starter pack ($1075 per additional node)
yes	yes	yes	Horizon Technology	(02) 498 6611	$553 per node (plus one-off software fee of $479)
yes	yes	yes	Horizon Technology	(02) 498 6611	$553 per node (plus one-off software fee of $3400)
yes	yes	yes	Data Peripherals	(02) 888 5733	$4500 starter pack ($1120 per node)
yes	yes	yes	IBM Australia	(02) 634 9111	$1617 adaptor card, software & 15m calde. ($1878 per node)
yes	yes	yes	IBM Australia	(02) 634 9111	$1400 per ring $1400 per node (software $230 per node)
yes	yes	yes	IDEAssociates	(02) 387 5222	$2380 starter pack
yes	yes	no	IDEAssociates	(02) 387 5222	$1100 starter pack
yes	yes	yes	Data Peripherals	(02) 888 5733	$27,148 (for 4 users) (incl. file server with 20Mb hard disk)
yes	yes	yes	Data Peripherals	(02) 888 5733	from $4500 (for 2 users)
yes	yes	yes	Data Peripherals	(02) 888 5733	$4888 starter pack Additional nodes $1327 (additional per node cost)
yes	yes	yes	Data Peripherals	(02) 888 5733	$5898 starter pack ($1440 per additional node)
yes	yes	yes	Porchester Computers	(03) 537 2722	$989 per node (plus a one-off $145 for PC-net software or $1990 for Netware software)
yes	yes	yes	Intelligence Systems	(03) 543 7988	$4794 (starter pack) (plus $714 per node)
yes	no	yes	Software Corporation	(03) 699 7255	$300 (starter pack)
yes	yes	yes	Network Solution Australia	(02) 957 2655	POA
yes	yes	yes	Software Product Support	(02) 419 5879	$1284 Starter Pack ($238.80 per additional node)
yes	yes	no	Software Product Support	(02) 419 5879	$1284 starter pack ($238.80 per additional node)
yes	yes	yes	Sourceware	(02) 411 5711	Ethernet board approx $1600 Manager software approx $1600 plus per node approx $900
yes	yes	yes	Data Bridge	(02) 819 6474	POA
no	no	yes	Pacific Data Corporation	(02) 290 1122	POA
yes	yes	yes	Wang Australia	(02) 925 5665	$980 per node LIO Card (incl. software) $980 repeater box
yes	yes	yes	Wang Australia	(02) 925 5665	POA
yes	yes	yes	Wang Australia	(02) 925 5665	$3200 starter pack
yes	yes	yes	SNS Computer Systems	(02) 958 2399	approx. $1600 per node



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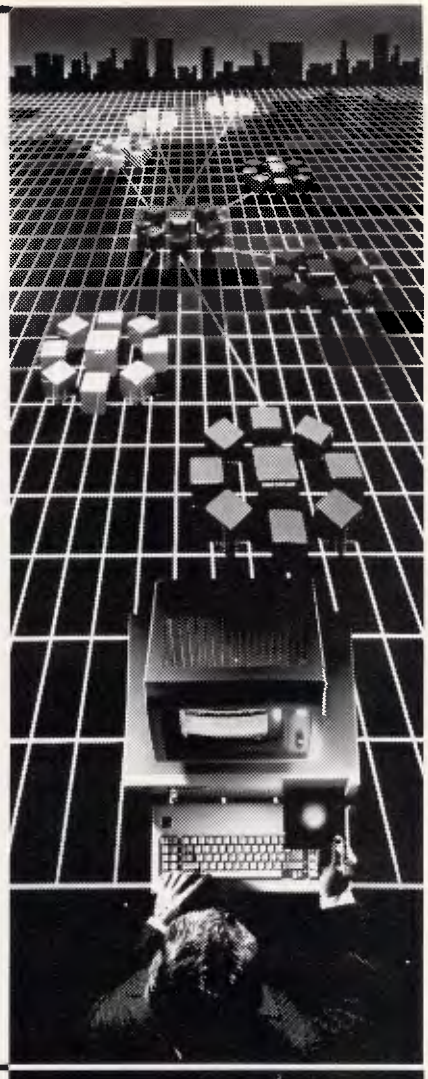

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Specifications:

Source media:	Any hard disk. No size limits
Destination Media:	Any removable disk for destination
Backup time:	First time if full-1 hour per 10 meg. Daily backups - Only modified files are copied. Average 10 minutes.
Files size:	No limit.
Number of files:	No limit.
Program size:	Approx. 32Kbytes.
Memory requirement:	48 bytes minimum.

Mike Mudge invites you to pit your wits against the 'postage stamp problem', and presents the winning Sociable Numbers from the June issue.

The particular postage stamp problem we are concerned with is as follows: an envelope may carry no more than s-stamps, there are available p-integer valued stamp denominations.

Given s and p, find the maximum integer n; (which depends upon s and p, thus we write n=n(s,p)), such that all integer postage values from 1 to n can be displayed upon the envelope. Further, determine all possible sets of p-stamp denominations satisfying this condition.

An equivalent problem, which is often encountered in the literature, includes a stamp of face value zero and then requires that each envelope carry exactly s-stamps. Notice that here, any shortfall from s with the p-integer valued stamps is made up with zero valued stamps, which are not real and hence do not appear in the count of p.

This may appear confusing, but hopefully the following examples clarify the situation:

For example:

(i) s=2, p=3. Here n(2,3)=8. The unique solution set is given by (0, 1, 3, 4) and envelopes are stamped thus: 0+1=1, 1+1=2, 0+3=3, 0+4=4, 1+4=5, 3+3=6, 3+4=7 and 4+4=8. We have displayed all integer postage values from 1 to 8 using exactly two stamps (including the zero value stamp where needed) drawn from the solution set.

(ii) s=2, p=6. Here, n(2,6)=20. There are now five solution sets: (0,1,2,5,8,9,10); (0,1,3,4,8,9,11); (0,1,3,4,9,11,16); (0,1,3,5,6,13,14); and (0,1,3,5,7,9,10).

(iii) n(1,m)=m with unique solution set (0,1,...m).

(iv) n(t,1)=t with unique solution set (0,1).

It has been shown that n(h,2)=entier $((h^2+6h+1)/4)$, where entier defines the smallest integer not greater than, for example, entier (3.14)=3.

If h is odd, then the unique solution set is (0,1,(h+3)/2). However, if h is even, there are two solution sets (0,1,(h+2)/2) and (0,1,(h+4)/2).

The only other case for which a nearly complete solution is known to the author is that for which p, the number of stamp denominations available, is 3.

G Hofmeister has shown that:
$(4/81)s^3 + (2/3)s^2 + (66/27)s \leq n(s,3) \leq (4/81)s^3 + (2/3)s^2 + (71/27)s - 1/81$ if s is greater than or equal to 34.

It has been further suggested, by RK Guy, that for s large enough, n(s,p) is given by a finite set of polynomials in s of degree p.

Note A polynomial of degree n in x is simply an expression of the form: $a_0 + a_1x + a_2x^2 + a_3x^3 + ...a_nx^n$: where a_0, a_1, ...a_n are known coefficients.

Thus the solution for n(h,2) given above may be written:
$n(h,2) = (h^2 + (3+3c)h + d)/4$ where $c=d=h$, mod 2.

Recall that $p=q$ mod r means that p and q leave the same remainder when divided by r: we read 'p is congruent to q modulo r.'

Guy's conjecture for p=3 is that for s greater than 19:
$n(s,3) = (4s^3 + 54s^2 + (204 + 3c_r)s + d_r)/81$
where c_r and d_r are given for $s=r$ mod9 (see Table 1).

The known results, which may be used as test cases for computer programs, are given in Table 2.

Interested readers are invited to investigate this postage stamp problem using any combination of 'trial and error', 'logical search' or algebraic analysis combined with suitable practical implementation.

The objectives include:

(i) the tabulation of results for n(h,2) . . . an inherently trivial exercise using the given formula.

(ii) the numerical investigation of the Hofmeister inequality to display its actual content — that is, what does it really tell us about n(s,3) for a given s?

(iii) the conversion of Guy's table into actual values for n(s,3). How do these compare with the results of (ii) above?

(iv) the determination of n(s,p) for given s and p values . . . using the known results quoted above as test cases and extending the empirical knowledge of this function as far as possible.

Readers are invited to submit their attempts at the above to Mike Mudge, C/- *APC,* 2nd Floor, 215 Clarence Street, Sydney, 2000.

It would be appreciated if such submissions contained a brief summary of results, together with thoughts relating to this postage stamp problem in a form suitable for future publication in *APC.*

Submissions, which must reach me by 1 February 1987, will be judged using suitably vague criteria, and a prize will be awarded to the 'best' contribution received.

Please note that submissions can only be returned if a suitable stamped, addressed envelope is provided.

r	−4	−3	−2	−1	0	1	2	3	4
c_r	0	1	3	0	−2	0	3	1	0
d_r	46	−81	−1	−170	0	62	−26	0	−154

Table 1

s	2	2	2	2	3	3	3	3	4	4	4	5	14
p	3	4	10	13	3	5	7	10	3	6	8	6	4
n(s,p)	8	12	46	72	15	36	70	154	26	108	220	211	1094

Table 2

Sociable numbers

Several readers corrected the example of 12496 which is, in fact, a Sociable Number with index 5, since s(14536) =14264 and s(14264)=12496.

This was due to my copying, without verification, a result of Lokenath Debnath, *Number Theory with Electronic Computers, Int J Math Educ Sci Technol* 1982, v13, no5, pp603-617.

The sets of Sociable Numbers beginning with 1547860, 3317740, 3265940, 5753864 and 7538660 were revealed.

A number of interesting unsolved questions have been posed as a result of investigations of this problem. Details are available on request.

A recent paper by W Borho and H Hoffman, *Math Comp,* v46, no171, pp281-293, generates 3501 new amicable pairs and is very readable, as the title 'Breeding Amicable Numbers in Abundance' suggests.

This month's prize-winner is Gareth Suggett who in addition to extensive numerical investigation and attempted generalisation, has studied the relevant results to be found in RK Guy's *Unsolved Problems in Number Theory.*

END

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DIARY DATA

Readers are strongly advised to check details with exhibition organisers before making travel arrangements to avoid wasted journeys due to cancellations, printers' errors, etc.

Geelong	IREECON Contact: Heather Harriman (02) 29 4051	November 30 - December 4, 1986
Singapore	Singapore Informatics '86 Contact: Suzanne, Singapore 474 6757	December 5-6, 1986
Melbourne:	Finance '87 Contact: BPI Exhibitions, 162 Goulburn Street, Darlinghurst NSW 2010 (02) 266 9799	February 17-20, 1986
Sydney	PC87 – The Eighth Australian Personal Computer Show Contact: Ms F Michael, Australian Exhibition Services, Suite 3.3, 424 St Kilda Road, Melbourne Vic 3004 (03) 267 4500	March 17-20, 1986

LAZING AROUND

Brain-teasers courtesy of JJ Clessa.

Of 100 people interviewed, 10 said they neither smoked nor drank, 75 said they drank, and 83 said they smoked.

How many people both drink and smoke?

Prize puzzle

When someone shouted 'Bingo', Fred still had nine numbers to get on his card. There was one number in each column, and three on each of the three rows on the card.

Fred noticed that one row contained three square numbers, one contained two squares and a prime, and the other contained one square and two primes. Moreover, the total of the three numbers in each row was the same.

What were the numbers, and which rows were they on?

(Note: the Bingo card contains 9 x 3 squares, and the first column contains numbers less that 11. The second column has numbers in the range 11-20, the third 21-30, and so on.)

Answers on postcards, please, or backs of envelopes, to reach us not later than 15 January 1987. Send your entries to *APC* Prize Puzzle December, 2nd Floor, 215 Clarence Street, Sydney 2000.

September prize puzzle

Not too difficult a problem.

The answer to the puzzle is that there are 191 numbers (excluding unity) which have no common factors with the number 720. The winning entry came from Duncraig, WA, and was from Mr Ken Brown. Congratulations Ken, your prize is on its way. END

MICROCHESS

A recent match between a Grandmaster and Hitech resulted in a comfortable win for the computer, as David Levy reports.

Shortly after the Fifth World Microcomputer Championship, a match was organised in London between Grandmaster Dr Jana Miles and Hitech. This was the first time that a match had been played between a computer and a human Grandmaster under normal match conditions. The result of the two-game match was a sensation — Hitech won both games and did so with some ease.

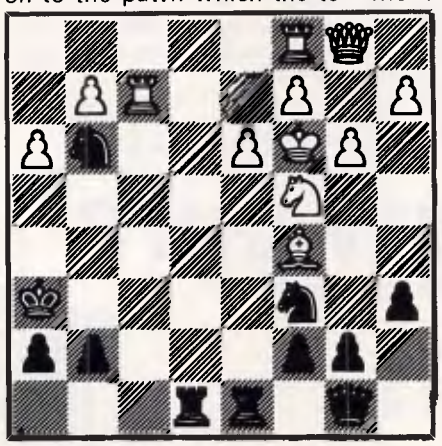
Jana confessed that she underestimated the machine in the first game, but in the second 'it efficiently neutralised my attack.' Hitech is currently rated at 2360 and is steadily improving. The World Chess Federation, which administers the world rating system, now has 124 member federations (it's the second largest sporting body in the world after FIFA — the world authority for soccer). Hitech's rating means that it would play on top board for the national team of 67 of those countries. There are now only 1000 humans on the world ranking list who play chess better than Hitech.

Here are the two games of the match.

White: Hitech. Black: Jana Miles.
Opening: Caro-Kann Defence.

1	e2–e4	c7–c6
2	d2–d4	d7–d5
3	Nb1–c3	g7–g6
4	h2–h3	Bf8–g7
5	Ng1–f3	Ng8–h6
6	e4xd5	c6xd5
7	Bf1–b5+	Bc8–d7
8	Bc1xh6	Bg7xh6
9	Qd1–e2	
9	. . .	O–O?

9 . . . Bd7–c6 is better — it hangs on to the pawn which the text move



9 . . . Bd7-d6 would be better

gives away.

10	Nc3xd5	Bd7xb5
11	Qe2xb5	Nb8–c6
12	c2–c3	a7–a6
13	Qb5–c5	Ra8–c8
14	O–O	e7–e6
15	Nd5–b6	Rc8–c7
16	Qc5–a3	Bh6–f4
17	Rf1–e1	Nc6–e7
18	c3–c4	Ne7–f5
19	Ra1–d1	Qd8–f6

White has completed its development and can now look for a breakthrough in the centre to capitalise on the extra pawn.

20	d4–d5	Bf4–d6
21	b2–b4	

The threat of c4–c5 is overwhelming, especially since Black cannot capture on d5 since White would recapture with the knight, forking queen and rook.

21	. . .	a6–a5
22	Qa3xa5	Qf6–c3
23	a2–a3	e6xd5

Now the fork follows, but Black's position is hopeless.

24	Nb6xd5	Qc3xc4
25	Nd5xc7	Bd6xc7
26	Qa5–c5	Qc4–f4
27	Rd1–d7	Bc7–b8
28	Re1–d1	b7–b6
29	Qc5xb6	Nf5–h4

The last throes of desperation. Black gets no attack for the piece. It's rather like watching a human-v-computer game in which you might expect the computer to push the unacceptable over its horizon.

30	Nf3xh4	Qf4–h2+
31	Kg1–f1	Qh2–h1+
32	Kf1–e2	Rf8–e8+
33	Ke2–f3	Qh1–h2
34	Qb6–f6	1–0

The horizon is no longer on a globe — it is now clearly part of the world view of the Flat Earth Society, so Black has no choice but to resign.

White: Jana Miles. Black: Hitech.
Opening: Grunfeld Defence.

1	d2–d4	Ng8–f6
2	c2–c4	g7–g6
3	Nb1–c3	d7–d5
4	e2–e3	e7–e6
5	Ng1–f3	Bf8–g7
6	b2–b4	Nb8–c6
7	Qd1–a4	Nf6–e4
8	Nc3xe4	

I prefer 8 Bc1–b2. It's true that the text move gives Black doubled pawns, but the pawn on e4 turns out to be very strong and very cramping.

8	. . .	d5xe4
9	Nf3–e5?	

9 Nf3–d2 is preferable. The text move loses a pawn, since White will not be able to defend the pawn on e5.

9	. . .	Bg7xe5
10	d4xe5	O–O
11	Bc1–b2	Qd8–g5
12	a2–a3	Nc6xe5
13	O–O–O	Ne5–d3+
14	Bf1xd3	e4xd3
15	Rd1xd3	Qg5xg2
16	Rh1–d1	Qg2xf2

White has a big lead in development and an unopposed bishop on the long diagonal. In many cases this would be more than enough compensation for two pawns, but not here, largely because the white queen finds it difficult to cooperate with her other pieces.

17	Qa4–a5	f7–f6

Starting to shut out the dangerous bishop.

18	Qa5xc7	e6–e5
19	Rd1–d2	Qf2–g1+
20	Rd2–d1	

20 Kc1–c2 would be met by 20 . . . Bc8–f5, winning even more material for Black.

20	. . .	Qg1xh2
21	Bb2–d4	

Since the bishop has been shut out, it must try to find another way into the game, but Black's reply is crushing.

21	. . .	Bc8–g4
22	Rd3–d2	Qh2–h4
23	Bd4–c5	Ra8–c8
24	Qc7–e7	Bg4xd1
25	Qe7–e6+	Kg8–h8
26	Bc5xf8	Bd1–a4
27	Rd2–h2	

White is busted, but would be happy to see 27 . . . Qh4xh2 28 Qe6xf6+ and 29 Qf6–g7 mate.

27	. . .	Qh4xc4+
28	Qe6xc4	Rc8xc4+
29	Kc1–b2	Kh8–g8
30	Bf8–h6	Kg8–f7
31	Rh2–d2	Rc4–h4

Black, now three pawns up, has everything under control.

0–1

White can now take advantage

END ZONE

BENCHMARKS

A list of Benchmarks used when evaluating micros is given below. An explanation can be found in the February '84 issue.

```
100 REM Benchmark 1
110 PRINT "S"
120 FOR K=1 TO 1000
130 NEXT K
140 PRINT "E"
150 END

100 REM Benchmark 2
110 PRINT "S"
120 K=0
130 K=K+1
140 IF K<1000 THEN 130
150 PRINT "E"
160 END

100 REM Benchmark 3
110 PRINT "S"
120 K=0
130 K=K+1
140 A=K/K*K+K-K
150 IF K<1000 THEN 130
160 PRINT "E"
170 END
```

```
100 REM Benchmark 4
110 PRINT "S"
120 K=0
130 K=K+1
140 A=K/2*3+4-5
150 K<1000 THEN 130
160 PRINT "E"
170 END

100 REM Benchmark 5
110 PRINT "S"
120 K=0
130 K=K+1
140 A=K/2*3+4-5
150 GOSUB 190
160 IF K<1000 THEN 130
170 PRINT "E"
180 END
190 RETURN

100 REM Benchmark 6
110 PRINT "S"
120 K=0
```

```
130 DIM M(5)
140 K=K+1
150 A=K/2*3+4-5
160 GUSUB220
170 FORL=1 TO 5
180 NEXTL
190 IF K<1000 THEN 140
200 PRINT "E"
210 END
220 RETURN

100 REM Benchmark7
110 PRINT "S"
120 K=0
130 DIM M(5)
140 K=K+1
150 A=K/2*3+4-5
160 GOSUB 230
170 FOR L=1 TO 5
180 M(L)=A
190 NEXTL
200 IF K<1000 THEN 140
210 PRINT "E"
```

```
220 END
230 RETURN

100 REM Benchmark 8
110 PRINT "S"
120 K=0
130 K=K+1
140 A=K  2
150 B=LOG(K)
160 C=SIN(K)
170 IF K<1000 THEN 130
180 PRINT "E"
190 END
```

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- Two RS-232C serial ports (1 STD, 1 OPT)
- One parallel printer port
- Game control adapter
- Clock/calendar

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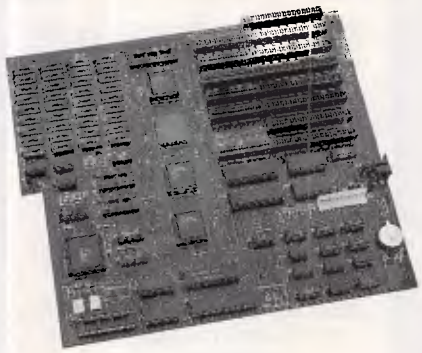
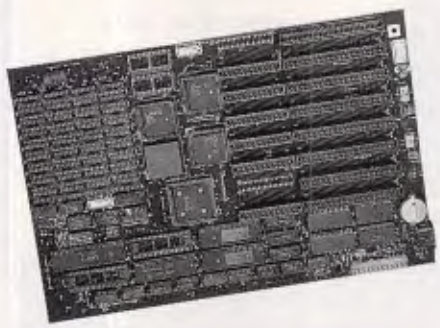
- Legal BIOS
- Optional printer port

KW-522 AT Main Board



Features:
- 2-LAYER P.C. board
- 80286 running at 8MHZ clock
- 1 megabyte DRAM on board using 41256-15 (optional)
- 5 custom chips
- CMOS clock and calendar circuit
- Socket for 80287 math coprocessor (optional)
- Replaceable on-board battery
- Optional legal BIOS or without ROM

KW-532 Baby AT Main Board



Features:
- 4-layer PCB.
- 80286 running at 8 MHZ or 6 MHZ
- 1 megabyte DRAM on board using 41256-15 (optional)
- 5 custom chips
- CMOS clock and calendar circuit
- Socket for 80287 math coprocessor (optional)
- Replaceable on-board battery
- Optional legal BIOS or without ROM

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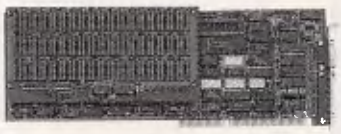

Features:
- Two RS-232C serial port (1 STD, 1 OPT)
- One parallel printer port
- One game control adapter
- Fully socketed memory with parity check
- Being expandable up to 3MB

KW-523 Multi-I/O Card

Features:
- Two RS-232C serial ports (1 STD, 1 OPT)
- One parallel printer adapter
- One game control port
- One controlling port supporting 2×5¼" 1.2MB FDD.

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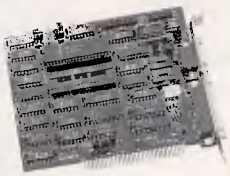

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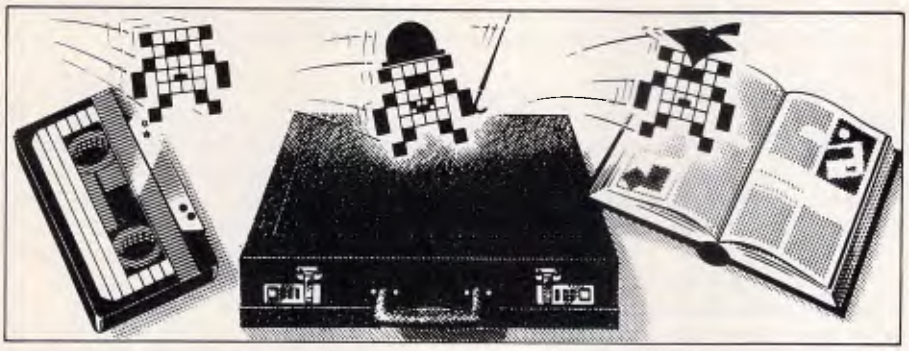
PROGRAM FILE



Games

Scientific/mathematic

Business

Toolkit/utilities

Educational/Computer Aided Learning

Owen Linderholm selects the best of readers' programs. For details on submitting your own, see the end of this section.

State of submissions

Most of the programs this month are utilities, some based on programs that have been published in 'Program File' in the past. Lately, I have detected a lot of uniformity in the programs submitted to 'Program File'. By far the largest group of programs I receive are utilities. Most of these are the type of program that is published regularly everywhere, but some are unusual, useful and well-written. The areas which have been completely hacked to death are sprite editors, character editors, disk sector editors, disassemblers and screendumps.

Another type of program that I receive far too many of is the data-base, and almost all of them make the mistake of being too simple and too specific. Simple databases are extremely useful if they address a particular data manipulation problem directly, but they are too specialised to be of much use for many applications. Databases sent to 'Program File' that are more complex are rarely well-written enough to be easy to use and flexible: this is why I don't publish many databases in 'Program File' and don't really expect to. My reasoning is that the majority of people want simple databases, which are readily available or which they could write themselves. Those who want more complex and powerful systems will be willing to pay for professional products.

Games are a problem for 'Program File'. Most are poorly written and not very exciting, but occasionally professional, arcade-quality games are sent in. The trouble is that the better games are usually written in machine code and involve huge amounts of hex data being typed-in. This is a very difficult, time-consuming and error-prone job, so I avoid it. Many people find even the ordinary Basic listings difficult to type-in.

One area that is interesting and seems to be growing is languages. Recently I have received interpreters written in Basic, Pascal and machine code for five or six languages (often cut-down versions), including a couple of invented languages. The problem with these is that since they are written in other interpreted languages (in most cases), they are extremely slow. Nevertheless, they demonstrate all sorts of useful programming techniques and practices.

The 'hints and tips' section of 'Program File' ('TJ's Workshop' as was) is still undersubscribed. I only receive slightly more tips than I need to use, and this means that the variety and usefulness of the tips is limited. So please, if you know a good hint for your machine or for a piece of software, send it in.

The two areas for which I *never* receive enough programs are education and science. These areas have problems peculiar to themselves, but still offer the possibility of originality and usefulness. Educational and scientific programs are hard to write for general use, but for different reasons. Most scientific programs are written to perform a specific function and are useless in other cases. An example is the set of programs used by one group of researchers in the physiology department of a university. They use a PDP11 to analyse data gathered on magnetic tape about glial cells in the retina. This data is analysed using software that is generally written specifically for the purpose, or adapted from similar programs written by people working in the same field. It's quite difficult to think of a general way of writing programs so that they have a wide range of applications and can be used for several purposes.

Educational programs are hard to write because it's very difficult to program a computer with a flexible teaching method that can adapt to different speeds of learning, different abilities, but which can also deal with side issues that aren't directly relevant but do have some bearing on the subject being taught. All these factors come into play in teaching, although in different ways at different levels, and very few educational programs take sufficient account of them.

This month's programs

Program of the Month is a utility to reduce the size and running speed of Amstrad CPC Basic programs. It has been written by JJ Walker. Many people don't realise that reducing the size of a Basic program also makes it run more quickly. The same is true if REM statements are removed and if the shortest, simplest variables are used. Doing this carefully can result in quite surprising speed increases, sometimes more than 10 per cent.

Much greater speed increases can be achieved by taking care when writing the program. If loops are simplified and optimised so that they perform the minimum of work, then huge speed increases can be achieved. One of the most common errors is to set a constant within a loop. This means that the constant is reassigned each time the loop is performed, which is a completely unnecessary action.

The other major area of speed improvement is when considering alternative ways of doing something. Many functions that you wish the computer to perform can be programmed in several ways. It's worth taking the time to consider which will run quickest, rather than plumping for the option that is easiest to program. This does involve knowing something about the way your computer performs commands, but it often turns out that a slightly more difficult way of

programming a procedure is far quicker when the code is executed.

Another program this month is Turbo Pascal Gulper. This is a game similar to Pacman and is written in Turbo Pascal. It demonstrates that it isn't necessary to write a program so that no-one can read it in order to produce a good game. Of course, this is easier in Pascal, which is compiled, but even so it's possible to write a game in structured Basic and still have it work successfully.

For the Commodore 64, there's a program that provides a fast way to plot graphs/points onscreen. Admittedly the points are a bit chunky (about one sixth of a character), but the program is small and works very quickly, and can be used from Basic.

BBC Automatic Disk Menu provides a disk menu for the BBC Micro from which any kind of program can be run with one key press. The program also provides useful information about the storage space left on the disk, and other goodies.

For the Spectrum, there's a program that provides a method of putting Pascal-like procedures in Basic programs, thus increasing the legibility and structure of large programs as well as providing programming flexibility.

Remember — all submissions to Program File should be accompanied by a stamped, addressed envelope to guarantee the prompt return of rejected programs.

APC is interested in programs written in any of the major programming languages for all home and small business micros. When submitting programs please include a cassette or disk version of your program, brief but comprehensive documentation, and a listing on plain white paper — typed if you have no printer.

Please ensure that the software itself, the documentation and the listing are all marked with your name, address, program title, machine (along with any minimum requirements) and — if possible — a daytime phone number.

Check through the previous Program Files to see the kind of programs we prefer. As a rough guide, original ideas are always welcome, as are good implementations of utilities and applications. Obviously the programs should be well-written, easy to understand, and preferably not too long (remember that other readers have to type them in).

All programs should be fully debugged and your own original, unpublished work. We prefer to receive programs with a maximum 80-column width printed in emphasised typeface.

We will try to return submissions if they are accompanied by a stamped, addressed envelope of the appropriate size, but please keep a copy of everything. Programs are paid for at the rate of $20 per page of published listing.

Send your contributions to APC Programs, Att. Stephen Crowley, P.O. Box 666, Fitzroy 3065.

Programs may also be sent to APC through Microtex 666's Direct Upload Facility (DUF). It's available on (03) 419 0856, accepts baud rates of 300, 1200 and 2400 (8 data bits, one stop bit, no parity), and runs each week night from 5.30pm. The system accepts ASCII and Xmodem file transfer standards. It's not restricted to 666 members.

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Program of the Month
Amstrad CPC Progdoc

by JJ Walker

This is a utility program for the CPC464/664/6128. It allows you to trim finished and debugged programs down to a minimum size and so improve execution speed slightly.

When the program is run, it splits the screen into two information windows with a larger display window between them. Below the lower information window is the command window which has a > prompt, ready to accept a command. There are 16 commands, as follows:

CAT — displays a catalogue of the disk in the drive, and could be omitted if the program were to be converted for tape-only use.

CLS — clears the display window if it starts to get messy.

EDIT — once a file has been loaded into memory, this command can be used to edit lines within the file. You are prompted for a line number; if no number is entered, the program returns to the command prompt. Alternatively, E xxxx will work as the edit command and take you straight to editing line xxxx. After editing, you will be asked for confirmation and may return to the command prompt.

FILESPACE — this command may only be used before loading a file. It should be used before loading a large file (over 30k) but isn't necessary otherwise. Filespace defaults otherwise to 1000, which represents the number of lines in the program you wish to load and must be set equal to or higher than that number. The amount of filespace used will be displayed in the upper information window. An abbreviation for this command is FS xxxx.

FIND — typing FIND, or the abbreviation F, will bring up a prompt for a string to search for. This can be anything at all and is case-dependent, so 'THIS' and 'this' are different. The search is global, and the numbers of the lines in which the string is found will be displayed in the upper information window. The command does not alter anything in memory.

HELP — this (or H) will give a list of commands in the display window.

LIST — this command has two actions. LIST, or the abbreviation LS, will list the whole program in memory to the display window. It can be aborted at any time by pressing the space bar. Use the sequence ESC — SPACE to pause and restart. LIST xxxx or LS xxxx will list the line xxxx only.

LOAD — this prompts for a filename. Pressing ENTER alone will return to the command prompt. Alternatively, LOAD filename or L filename will load-in the file directly. All files loaded must be in ASCII format.

PRINT — this, or P, will send the program in memory to a printer. You will be asked for confirmation but may not abort once confirmed.

PRINT ELITE — this will send the code for Elite font printing to a printer. Nothing is performed physically except a carriage return to realign the print head. The code in the program is for Epson compatibles and is on line 1330. The abbreviation is P ELITE.

PRINT PICA — exactly the same as PRINT ELITE but for Pica printing. The code is on line 1320.

QUIT — this can be abbreviated to Q, and you are asked for confirmation in case you make a mistake.

REPLACE — this prompts for a string to be replaced, followed by a prompt for replacement. This command must be used with care since it can alter large parts of a program. The replacement will be global, so *all* occurrences of the target string will be replaced. When replacing string variables, remember to include the $, or integer or real variables of the same name will also be replaced. The search will also replace everything of the same name between quotes in the PRINT statements or in REM statements. It will *not* replace the string if it's part of a longer alphabetic string; this is done in line 1260 of the program by checking that the character on either side of the string is lower than an ASCII 'A'. The line numbers in which a replacement has occurred will be displayed on the screen. The command can be abbreviated to R.

SAVE — similar to LOAD. The file saved is an ASCII version and should be reloaded to be run as an ASCII file.

TRIM — this command goes through the program, removing *all* comments. If you're in the habit (you shouldn't be) of sending control of your program to REM statements by GOTOs, and so on, then you'll need to alter your programming style or line 1540 of the program listing to take account of this (outline$ = lineno$ + ":" should do the trick). Once again, the search is not tokenised, so if your program includes the groups :REM or :' anywhere other than a comment, be careful. Whole comment lines will be truncated to just the line number, and LIST will show you where they have been removed. You can use EDIT to put back any comments. The blank line numbers will be discarded when the file is saved.

ZAP — this command (or Z) will clear all the memory and start again. You will be asked for confirmation, and it's safer to use SAVE before taking such a drastic step.

When typing-in the listing, you may safely leave out all comments, or alternatively use the program on itself as a test. Watch out for line 1700.

You can alter the colour used from white on blue in line 110.

Using Progdoc

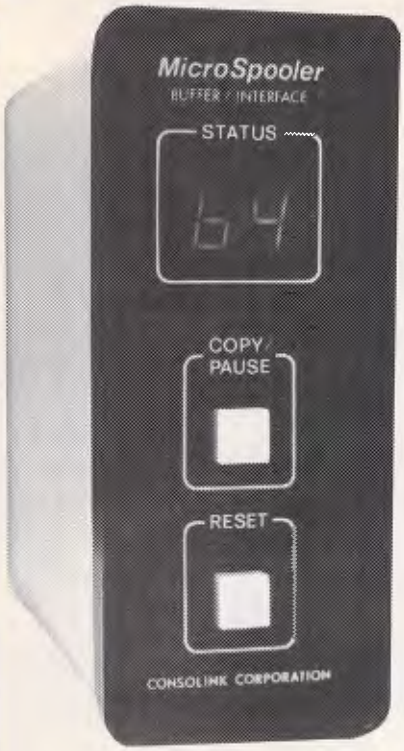
First, load the program you want to work on. Renumber it with RENUM 1,1,1 and make a note of the last line number to ensure that FILESPACE is set larger than it. You can then restore normal numbering with RENUM. Then save the program in ASCII format using SAVE"filename",A.

Now run Progdoc. At the command prompt enter FS xxxx where xxxx is greater than the highest line number previously noted. This isn't necessary if your program is less than 1000 lines.

You can now load the program to work on. Type 'LOAD filename <ENTER>' where filename is the name of the ASCII version of the program you have just saved. The program will take a few moments to load. Various errors can occur at this stage if FILESPACE is too low or the wrong filename is used. Once the program is loaded, type LIST as a check. Press the space bar when you have seen enough.

It's best to use TRIM before REPLACE. Now type TRIM and your program will scroll through the display window but with the comments removed. You can pause this process by pressing ESC and start it again with SPACE, but don't press ESC twice or you'll break out of the program. If you do accidentally break out, type GOTO 150 for a warm restart.

When TRIM is finished, you can start REPLACE-ing. It's a good idea while doing this to consult a copy of the original listing to check the original variable names.



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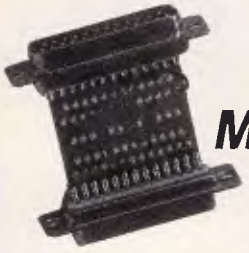

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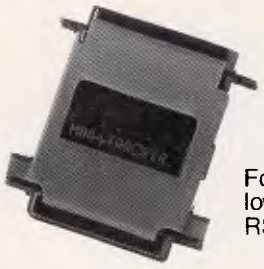

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If the original variable names are in lower-case, replace them with short upper-case names. This makes them stand out from the original names.

Do a SAVE at regular intervals when using REPLACE, since it's easy to make mistakes. Remember to use a different name for each version, as it can be frustrating to have to go back and start from scratch.

A slower alternative to REPLACE is the FIND — EDIT sequence. Use FIND to display all the line numbers your variable is in, then step through each of these using EDIT xxxx. The latter command will display the original line, with the line number displayed separately below. The altered line can then be typed-in following this. When you press ENTER, you will be asked for confirmation. If you press N, the original line will remain unchanged. To abort EDIT quickly, press ENTER in response to the empty line number, followed by N.

To convert Progdoc to tape

Load Progdoc and type the following direct Basic commands:

DELETE 300 (remove the CAT command)

DELETE 500 (remove the CAT command summary)

DELETE 1440 (remove the CAT subroutine)

DELETE 710 (to allow you to load unnamed files)

DELETE 820 (to allow you to save unnamed files)

Deleting lines 710 and 820 won't let you abort a load at the prompt, so leave them in if you want to retain this program.

```
10 REM ******************************************************************************
20 REM ******************************************************************************
30 REM *                                                                            *
40 REM *           PROGDOC v1.02d (for the Amstrad 464/664/8128)                    *
50 REM *                                                                            *
60 REM *      This DISC version  Copyright (c) August 1986  J.J.Walker              *
70 REM *                                                                            *
80 REM ******************************************************************************
90 REM ******************************************************************************
100 CALL &BC02:CALL &BB4E
110 MODE 2:INK 1,26
120 GOSUB 2170:'initialisation
130 GOSUB 2100:'screen set up
140 GOSUB 380:'update info windows
150 ON ERROR GOTO 220:'leave this out until you've got the program running.
If it stops with an Unknown Error message, it's because this line is missing.
160 WHILE TRUE
170 LINE INPUT ">",in$:in$=UPPER$(in$):GOSUB 420:ok=FALSE
180 IF command$="QUIT"OR command$="Q"THEN ok=TRUE:GOSUB 450
190 IF command$="HELP"OR command$="H"THEN ok=TRUE:GOSUB 460
200 IF command$="LOAD"OR command$="L"THEN ok=TRUE:GOSUB 690
210 IF command$="SAVE"OR command$="S"THEN ok=TRUE:GOSUB 600
220 IF command$="ZAP"OR command$="Z"THEN ok=TRUE:GOSUB 900
230 IF command$="PRINT"OR command$="P"THEN ok=TRUE:GOSUB 1300
240 IF command$="TRIM"OR command$="T"THEN ok=TRUE:GOSUB 1470
250 IF command$="FILESPACE"OR command$="FS"THEN ok=TRUE:GOSUB 940
260 IF command$="FIND"OR command$="F"THEN ok=TRUE:GOSUB 1130
270 IF command$="REPLACE"OR command$="R"THEN ok=TRUE:GOSUB 1000
280 IF command$="EDIT"OR command$="E"THEN ok=TRUE:GOSUB 1740
290 IF command$="LIST"OR command$="LS"THEN ok=TRUE:GOSUB 1870
300 IF command$="CAT"THEN ok=TRUE:GOSUB 1440
310 IF command$="CLS"THEN ok=TRUE:CLS#2
320 IF ok=FALSE AND command$<>""THEN ERROR 60:'unknown command
330 WEND
340 '
350 'SUBROUTINE: to print information to the two information windows.
360 LOCATE#1,1,1:PRINT#1," Program:  ";filename$;TAB(28);
370 PRINT#1,USING"Filespace used: #### / #### maximum";actualsize;defaultsize
380 LOCATE#1,68,1:PRINT#1,"Free:";FRE("")
390 LOCATE#3,2,1:PRINT#3,USING"First line: #####  Last line: #####";firstline;la
```

```
stline:LOCATE#3,40,1:PRINT#3,"PROGDOC   Type HELP for Command Summary":RETURN
400 '
410 'SUBROUTINE: to split the command sentence at the first space.
420 a=INSTR(in$," "):IF a=FALSE THEN parameter$="":command$=in$:RETURN ELSE para
meter$=MID$(in$,a+1):command$=LEFT$(in$,a-1):RETURN
430 '
440 'SUBROUTINE: to confirm user's choice to quit.
450 PRINT"QUIT confirm (y/n)? ";:GOSUB 2030:IF choice=yes THEN END ELSE RETURN
460 '
470 'SUBROUTINE: to display the command summary page.
480 WINDOW SWAP 0,2
490 PRINT"Command          Abbreviation"
500 PRINT"CAT              - CAT"
510 PRINT"CLS              - CLS"
520 PRINT"EDIT             - E   optional line number"
530 PRINT"FILESPACE        - FS  optional number"
540 PRINT"FIND             - F"
550 PRINT"HELP             - H"
560 PRINT"LIST             - LS  optional line number"
570 PRINT"LOAD             - L   optional filename"
580 PRINT"PRINT            - P"
590 PRINT"PRINT ELITE      - P ELITE"
600 PRINT"PRINT PICA       - P PICA"
610 PRINT"QUIT             - Q"
620 PRINT"REPLACE          - R"
630 PRINT"SAVE             - S   optional filename"
640 PRINT"TRIM             - T"
650 PRINT"ZAP              - Z"
660 WINDOW SWAP 2,0:RETURN
670 '
680 'SUBROUTINE: to load a file into memory.
690 IF fileinmemory=TRUE THEN ERROR 90
700 IF parameter$=""THEN LINE INPUT"LOAD filename: ",parameter$
710 IF parameter$=""THEN RETURN:'abort if no filename given
720 filename$=parameter$:GOSUB 360
730 OPENIN filename$:DIM program$(defaultsize):count=0
740 WHILE NOT EOF:count=count+1:LINE INPUT#9,program$(count):WEND:CLOSEIN
750 firstline=VAL(program$(1)):lastline=VAL(program$(count))
760 actualsize=count:fileinmemory=TRUE
770 GOSUB 360:PRINT CHR$(11);"LOAD successful";CHR$(18):RETURN
780 '
790 'SUBROUTINE: to save a previously read in file.
800 GOSUB 2000:'check that a file is in memory
810 IF parameter$=""THEN LINE INPUT"SAVE filename: ",parameter$
820 IF parameter$=""THEN RETURN:'abort if no filename given
830 filename$=parameter$:GOSUB 360
840 OPENOUT filename$:FOR count=1 TO actualsize
850 IF INSTR(program$(count)," ")THEN PRINT#9,program$(count)
860 NEXT:CLOSEOUT
870 GOSUB 360:PRINT CHR$(11);"SAVE successful";CHR$(18):RETURN
880 '
890 'SUBROUTINE: to clear file from memory.
900 GOSUB 2000:'check that a file is in memory
910 PRINT"ZAP confirm (y/n)? ";:GOSUB 2030:IF choice=yes THEN RUN ELSE RETURN
920 '
930 'SUBROUTINE: to adjust the default filespace to user's requirements.
940 IF fileinmemory=TRUE THEN ERROR 90
950 IF parameter$=""THEN LINE INPUT"NEW Filespace: ",parameter$
960 IF parameter$=""THEN filespace=defaultsize ELSE filespace=VAL(parameter$)
970 defaultsize=ABS(filespace):GOSUB 360:RETURN
980 '
990 'SUBROUTINE: to search for & replace one string for another.
1000 GOSUB 2000:'check that a file is in memory
1010 LINE INPUT"String to find: ",targetstring$:IF targetstring$=""THEN RETURN
1020 LINE INPUT"Replace string: ",newstring$:IF newstring$=""THEN RETURN
1030 targetlen=LEN(targetstring$):found=FALSE:PRINT#2
1040 FOR count=1 TO actualsize:IF found THEN count=count-1
1050 found=FALSE:GOSUB 1210:IF found=FALSE THEN 1100
1060 a=INSTR(thisline$,targetstring$)
1070 thisline$=LEFT$(thisline$,a-1)+newstring$+MID$(thisline$,a+targetlen)
1080 statement$=thisline$:GOSUB 1610:'strip trailing space
1090 program$(count)=statement$:PRINT#2,USING"#####   ";VAL(thisline$);
```

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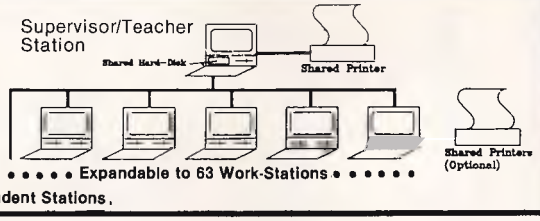

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1100 NEXT:PRINT#2:PRINT#2:GOSUB 360:RETURN
1110 '
1120 'SUBROUTINE: to find all occurences of a target string
1130 GOSUB 2000:'check that a file is in memory
1140 LINE INPUT"String to find: ",targetstring$:IF targetstring$=""THEN RETURN
1150 targetlen=LEN(targetstring$):PRINT#2
1160 FOR count=1 TO actualsize:found=FALSE:GOSUB 1210
1170 IF found THEN PRINT#2,USING"#####   ";VAL(thisline$);
1180 NEXT:PRINT#2:PRINT#2:RETURN
1190 '
1200 'SUBROUTINE: used by find AND replace to scan each line of the program
1210 thisline$=program$(count)+" ":linelen=LEN(thisline$)
1220 IF INSTR(thisline$,targetstring$)=FALSE THEN found=FALSE:RETURN
1230 FOR loop=1 TO linelen
1240 IF MID$(thisline$,loop,targetlen)<>targetstring$ THEN 1270
1250 check$=MID$(thisline$,loop-1,targetlen+2)
1260 IF LEFT$(check$,1)<"A"AND RIGHT$(check$,1)<"A"THEN found=TRUE
1270 NEXT:RETURN
1280 '
1290 'SUBROUTINE: to send control codes to printer or print file in memory.
1300 IF INP(&F500)AND 64 THEN ERROR 70:'check that printer is on-line
1310 codesent=FALSE
1320 IF parameter$="PICA"THEN PRINT#8,CHR$(27);"P":codesent=TRUE
1330 IF parameter$="ELITE"THEN PRINT#8,CHR$(27);"M":codesent=TRUE
1340 IF codesent=TRUE THEN PRINT"Code sent":RETURN:'from sending a code
1350 IF codesent=FALSE AND parameter$<>""THEN ERROR 80:'unknown command
1360 GOSUB 2000:'check that a file is in memory
1370 PRINT#8:'only if command is PRINT or P alone
1380 PRINT"PRINT confirm (y/n)? ";:GOSUB 2030:IF choice<>yes THEN RETURN
1390 FOR count=1 TO actualsize
1400 IF INSTR(program$(count)," ")THEN PRINT#8,program$(count)
1410 NEXT:GOSUB 360:RETURN:'from printing the program
1420 '
1430 'SUBROUTINE: to display a disc catalogue.
1440 WINDOW SWAP 0,2:CAT:WINDOW SWAP 2,0:RETURN
1450 '
1460 'SUBROUTINE: to trim all comments from the file.
1470 GOSUB 2000:'check that a file is in memory
1480 PRINT"Please wait. TRIM in progress...;"
1490 FOR count=1 TO actualsize:trimmed=FALSE:inline$=program$(count)
1500 a=INSTR(inline$," "):IF a=FALSE THEN outline$=inline$:GOTO 1570
1510 lineno$=LEFT$(inline$,a-1):statement$=MID$(inline$,a)
1520 GOSUB 1610:GOSUB 1650:'strip trailing & leading spaces
1530 IF INSTR(statement$,"REM")=FALSE THEN IF INSTR(statement$,"'")=FALSE THEN
outline$=lineno$+" "+statement$:GOTO 1560:'if no REM in line then get next
1540 IF LEFT$(statement$,3)="REM"OR LEFT$(statement$,1)="'"THEN outline$=lineno$
:trimmed=TRUE:'delete all comment lines
1550 IF NOT trimmed THEN GOSUB 1690:'trim comment from end of line
1560 IF INSTR(outline$," ")THEN PRINT#2,outline$
1570 program$(count)=outline$
1580 NEXT:PRINT#2:GOSUB 360:PRINT CHR$(11);"TRIM complete":CHR$(18):RETURN
1590 '
1600 'SUBROUTINE: to strip trailing spaces from end of a line
1610 WHILE RIGHT$(statement$,1)=" "
1620 statement$=LEFT$(statement$,LEN(statement$)-1):WEND:RETURN
1630 '
1640 'SUBROUTINE: to strip leading spaces from start of a line
1650 WHILE LEFT$(statement$,1)=" "
1660 statement$=RIGHT$(statement$,LEN(statement$)-1):WEND:RETURN
1670 '
1680 'SUBROUTINE: used by trim to cut off comment from end of a line.
1690 a$=statement$:z=LEN(a$):FOR loop=1 TO z
1700 IF MID$(a$,loop,5)=":REM "OR MID$(a$,loop,2)=":'"THEN a$=LEFT$(a$,loop-1)
1710 NEXT:outline$=lineno$+" "+a$:RETURN
1720 '
1730 'SUBROUTINE: to edit a line of the file in memory.
1740 GOSUB 2000:'check that a file a in memory
1750 IF parameter$=""THEN LINE INPUT"EDIT line no: ",parameter$
1760 IF parameter$=""THEN RETURN:'abort if no line number given
1770 GOSUB 1870:'list the line number specified
1780 oldline$=program$(count)
1790 a=INSTR(oldline$," "):IF a=FALSE THEN lineno$=oldline$ ELSE lineno$=LEFT$(o
ldline$,a-1)
```

```
1800 PRINT#2:PRINT#2,"TYPE in new line and ENTER to finish:"
1810 PRINT#2,lineno$;" ";:LINE INPUT#2,"",newline$:PRINT#2:IF newline$<>"" THEN
newline$=" "+newline$
1820 PRINT"EDIT confirm new line (y/n)? ";:GOSUB 2030
1830 IF choice=yes THEN program$(count)=lineno$+newline$
1840 GOSUB 360:RETURN
1850 '
1860 'SUBROUTINE: to list whole or one line of file in memory.
1870 GOSUB 2000:'check that a file is in memory
1880 linenumber=ABS(VAL(parameter$)):IF linenumber THEN 1920
1890 PRINT"Hit SPACE BAR to abort":count=0
1900 WHILE count<=actualsize AND INKEY$<>" ":count=count+1
1910 PRINT#2,program$(count):WEND:PRINT#2:RETURN:'from list all lines
1920 IF linenumber<firstline OR linenumber>lastline THEN ERROR 60
1930 PRINT#2:PRINT#2:count=0
1940 WHILE VAL(program$(count))<linenumber:count=count+1
1950 PRINT#2,CHR$(11);:WRITE#2,VAL(program$(count));:WEND
1960 IF linenumber<>VAL(program$(count))THEN ERROR 60
1970 PRINT#2,CHR$(11);program$(count):PRINT#2:RETURN:'from listing one line
1980 '
1990 'SUBROUTINE: to check that a file is in memory.
2000 IF fileinmemory=FALSE THEN ERROR 50 ELSE RETURN
2010 '
2020 'SUBROUTINE: to get a yes/no response from the user.
2030 PRINT CHR$(7);:choice=0
2040 WHILE choice=0:pressed$=UPPER$(INKEY$)
2050 IF pressed$<>""THEN choice=INSTR("YN",pressed$)
2060 WEND:IF choice=yes THEN PRINT"Confirmed"ELSE PRINT"Aborted"
2070 RETURN
2080 '
2090 'SUBROUTINE: screen set up.
2100 WINDOW#0,1,80,20,25:PAPER#0,0:PEN#0,1:CLS#0:'commands window
2110 WINDOW#1,1,80,1,1:PAPER#1,1:PEN#1,0:CLS#1:'top info window
2120 WINDOW#2,1,80,2,18:PAPER#2,0:PEN#2,1:CLS#2:'display window
2130 WINDOW#3,1,80,19,19:PAPER#3,1:PEN#3,0:CLS#3:'lower info window
2140 RETURN
2150 '
2160 'SUBROUTINE: initialisation
2170 WIDTH 80:DEFINT a-z
2180 TRUE=(-1):FALSE=0:yes=1
2190 defaultsize=1000:actualsize=0
2200 firstline=0:lastline=0
2210 fileinmemory=FALSE
2220 filename$="<< no file >>"
2230 RETURN
2240 '
2250 'ROUTINE: Error trap.
2260 IF ERR=9 THEN PRINT CHR$(11);"LOAD failed - insufficient Filespace":ERASE p
rogram$ ELSE IF ERR=14 THEN PRINT CHR$(7);"Run out of memory"
2270 IF ERR=25 THEN PRINT"File is not in ASCII format"ELSE IF ERR=50 THEN PRINT"
No file in memory"ELSE IF ERR=60 THEN PRINT"Line does not exist"
2280 IF ERR=70 THEN PRINT"Your printer is off-line"ELSE IF ERR=80 THEN PRINT"Unk
nown Command"ELSE IF ERR=90 THEN PRINT"File in memory - use ZAP to clear"
2290 CLOSEIN:CLOSEOUT:RESUME 160
```

Turbo Pascal Gulper

by Hamish Lawson

MICROTEX 666

This program is available electronically through Microtex 666's software downloading service. It is accessed through Viatel page *66637#.

This program is an ideal example of how to write a game program that is not machine-specific and in which the code is extremely easy to understand. The program is a simple one in the PacMan genre. It doesn't use any fancy graphics, only characters, therefore it can be translated easily to other machines. When the program is working, graphics routines can be added relatively easily to improve the look of the game.

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```
PROGRAM Gulper (input, output);

{These compiler directives are peculiar to Turbo Pascal                    }
{$I-,R+,V-,U-,K-,C-}

{ The program is written in Turbo Pascal for the IBM PC.  It may be easily  }
{ converted for other Pascals or computers if account is taken of the       }
{ comments immediately below, and of the comments in the procedure          }
{ assign_values, below                                                      }
{                                                                           }
{  > KBD used as parameter of read or readln prevents echo to screen of     }
{    characters being read                                                  }
{  > The program assumes a screen at least 80 columns wide and 24 lines deep }
{  > Procedures and functions peculiar to Turbo Pascal:                     }
{    PROCEDURES:                                                            }
{       GotoXY (x, y) - Moves cursor to column x and row y of screen; top   }
{          left corner is (1, 1)                                            }
{       ClrScr - Clears screen                                              }
{       Sound (f) - emits tone of frequency f in hertz until the procedure  }
{          NoSound is encountered                                           }
{       Delay (t) - pauses for t milliseconds                               }
{    FUNCTIONS:                                                             }
{       KeyPressed: BOOLEAN - returns value true if key has been pressed    }
{       Random (n: INTEGER): INTEGER - returns a 'random' integer greater or }
{          equal to 0 and less than n                                       }
{       UpCase (c: CHAR): CHAR - returns uppercase equivalent of character c }
{          if c is lowercase, else returns c                                }

   CONST

   depth = 19;
   width = 47;
   indent = 16;
   header = 0;
   no_ghosts = 2;
   dot_value = 1;
   ghost_value = 100;
   bonus_value = 500;
   fastest = 100;
   acceleration = 10;
   max_comp_bonus = 300;
TYPE
   position = RECORD
                 x: INTEGER;
                 y: INTEGER
              END;
   charstring = PACKED ARRAY [1..40] OF CHAR;
VAR
   gulper, reply, normal_gulper, super_gulper, ghost, wall, den: CHAR;
   bonus, key, square, power_pill, blank, terminal, dot: CHAR;
   gulper_pos, gulper_old_pos, choice, this_bonus_pos: position;
   i, lives, score, num_dots, wait_time, completion_bonus: INTEGER;
   this_ghost: 1..no_ghosts;
   bonuses, number_directions: 0..3;
   moves_count: 0..20;
   bonus_life: 0..50;

   distance, shortest, longest: REAL;
   grid: ARRAY [1..depth] OF ARRAY [1..width] OF CHAR;
   port: ARRAY [1..2] OF RECORD
                            entrance: position;
                            exit: position
                         END;
   ghost_pos, ghost_old_pos: ARRAY [1..no_ghosts] OF position;
   den_pos, bonus_pos: ARRAY [1..4] OF position;
   dead, bonus_on: BOOLEAN;

PROCEDURE assign_values;

{ If your computer's character set is different from the IBM PC's you may  }
{ have to assign other characters to these variables                        }

BEGIN
   normal_gulper := chr (2);     { face }
   super_gulper := chr (254);    { square: ~ }
   ghost := chr (1);             { inverse-video face }
   wall := chr (219);            { solidly coloured rectangle: / }
   den := chr (176);             { half-tone rectangle: @ }
   bonus := chr (3);             { heart shape }
   power_pill := chr (4);        { lozenge }
   blank := ' ';
   dot := '.';
   terminal := '£'
END; { assign_values }

PROCEDURE title_page;
   VAR
      row: 1..24;

   PROCEDURE sidescroll (slice: charstring);
      VAR
         i, j: 1..24;
   BEGIN
      FOR i := 1 TO 16 DO BEGIN
         GotoXY (1, row);
         FOR j:= 1 TO i DO
            write (' ');
         write (slice)
      END;
      row := row + 1
   END; { sidescroll }

BEGIN
   ClrScr;
   row := 5;
   sidescroll (' GGGG   UU  UU  LL      PPPPPP   EEEEEE  RRRRRR ');
   sidescroll ('GG  GG  UU  UU  LL      PP   PP  EE      RR   RR');
   sidescroll ('GG      UU  UU  LL      PP   PP  EE      RR   RR');
   sidescroll ('GG      UU  UU  LL      PP   PP  EEEE    RR   RR');
   sidescroll ('GG  GG  UU  UU  LL      PPPPPP   EE      RRRRRR ');
   sidescroll ('GG  GG  UU  UU  LL      PP       EE      RR  RR ');
   sidescroll (' GGGGG   UUUU   LLLLLL  PP       EEEEEE  RR   RR');
   GotoXY (20, 15);
   writeln ('By    H A M I S H    B    L A W S O N ');
   Delay (3000)
END; { title page }

PROCEDURE give_instructions;
   VAR
      i: 1..26;
      indent: ARRAY [1..26] OF CHAR;
BEGIN
   ClrScr;
   FOR i := 1 TO 26 DO
      indent [i] := ' ';
   writeln (indent, 'I N S T R U C T I O N S');
   writeln (indent, '-----------------------');
   writeln;
   write ('Move Gulper ',normal_gulper,' around the maze by means of ');
   writeln ('the numeric keypad:');
   writeln;
   writeln (indent, '         UP');
   writeln (indent, '         8');
   writeln (indent, 'LEFT  4     6  RIGHT');
   writeln (indent, '         2');
   writeln (indent, '       DOWN');
   writeln;
   write ('Your  aim is to eat all the dots whilst  avoiding the  gho');
   write ('sts ', ghost, ' chasing you.  If');
   write ('you eat a  power pill ',power_pill, ' you can then chase t');
   write ('he  ghosts.   Your ability to  chasegho');
   write ('sts is indicated  by the gulper changing to ', super_gulper);
   write (' :  you will also hear a pipping');
   write ('tone which will stop just before  time is up for  chasing ');
   write ('the ghosts.   A caught');
   write ('ghost (worth ', ghost_value, ' points) returns to one of t');
   write ('he central squares ', den, ' .  If you enter');
   write ('one of the teleports ', terminal, ' you will be transporte');
   write ('d to the other one; but beware! you');
   write ('have a 1 in 4 chance of being teleported into hyperspace. ');
   write ('Bonuses ', bonus, ' appear now');
   write ('and again and are worth ', bonus_value, ' points.   Howev');
   write ('er if you wish to get them  you will');
   writeln ('have to be quick: they only appear for a short time.');
   writeln;
   write ('Don''t take too long to eat the dots as the ghosts move fa');
   writeln ('ster all the time.');
   GotoXY (24,24)
END; { give instructions }

PROCEDURE make_grid;
   VAR
      i, j: INTEGER;

   FUNCTION rep (symbol: CHAR): CHAR;
   BEGIN
      CASE symbol OF
         'W': rep := wall;
         '.': rep := dot;
```

```
            ' ': rep := blank;
            't': rep := terminal;
            'p': rep := power pill;
            'd': rep := den
         END
      END; { rep }

   BEGIN
      grid [ 1] := 'wwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwww';
      grid [ 2] := 'wp.................wwwww.................pw';
      grid [ 3] := 'w.wwwww.wwwwwwww.www.wwwww.www.wwwwwwww.wwwww.w';
      grid [ 4] := 'w.wwwww.wwwwwwww.www.wwwww.www.wwwwwwww.wwwww.w';
      grid [ 5] := 'w.................www.....www.................w';
      grid [ 6] := 'wwwwwww.wwwww.wwwww..ww ww..wwwww.wwwww.wwwwwww';
      grid [ 7] := 'wwwwwww.wwwww.wwww..www www..wwww.wwwww.wwwwwww';
      grid [ 8] := 'w..........ww.www..www   www..www.ww..........w';
      grid [ 9] := 'w.wwwwwwww.ww.www.www  d  www.www.ww.wwwwwwww.w';
      grid [10] := 'w.  twwwww.......    dwd    ........wwwwwt  .w';
      grid [11] := 'w.wwwwwwww.ww.www.www  d  www.www.ww.wwwwwwww.w';
      grid [12] := 'w..........ww.www..www   www..www.ww..........w';
      grid [13] := 'wwwwwww.wwwww.wwww..www www..wwww.wwwww.wwwwwww';
      grid [14] := 'wwwwwww.wwwww.wwwww..ww ww..wwwww.wwwww.wwwwwww';
      grid [15] := 'w.................www.....www.................w';
      grid [16] := 'w.wwwww.wwwwwwww.www.wwwww.www.wwwwwwww.wwwww.w';
      grid [17] := 'w.wwwww.wwwwwwww.www.wwwww.www.wwwwwwww.wwwww.w';
      grid [18] := 'wp.................wwwww.................pw';
      grid [19] := 'wwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwww';
      port [1].entrance.x := 5; port [1].entrance.y := 10;
      port [1].exit.x := 4; port [1].exit.y := 10;
      port [2].entrance.x := 43; port [2].entrance.y := 10;
      port [2].exit.x := 44; port [2].exit.y := 10;
      den pos [1].x := 23; den pos [1].y := 10;
      den pos [2].x := 25; den pos [2].y := 10;
      den pos [3].x := 24; den pos [3].y := 9;
      den pos [4].x := 24; den pos [4].y := 11;
      bonus pos [1].x := 24; bonus pos [1].y := 6;
      bonus pos [2].x := 19; bonus pos [2].y := 10;
      bonus pos [3].x := 29; bonus pos [3].y := 10;
      bonus pos [4].x := 24; bonus pos [4].y := 14;
      num dots := 0;
      FOR i := 1 TO depth DO
         FOR j := 1 TO width DO BEGIN
            IF grid [i, j] = '.' THEN num dots := num dots + 1;
            grid [i, j] := rep (grid [i, j])
         END
   END; { make grid }

   PROCEDURE draw square (pos: position; square: CHAR);
   BEGIN
      WITH pos DO
         GotoXY (x + indent, y + header);
      write (square);
      GotoXY (1, 25)
   END; { draw square }

   PROCEDURE draw grid;
      VAR
         i, j: INTEGER;
   BEGIN
      FOR i := 1 TO depth DO BEGIN
         GotoXY (indent + 1, i + header);
         FOR j := 1 TO width DO
            write (grid [i, j])
      END;
      FOR i := 1 TO no ghosts DO
         draw square (ghost pos [i], ghost);
      draw square (gulper pos, normal gulper)
   END; {draw grid}

   FUNCTION hyp sqr (ghost pos: position): REAL;
   BEGIN
      WITH gulper pos DO
         hyp sqr := sqr (x - ghost pos.x) + sqr (y - ghost pos.y)
   END; { hyp sqr }

   PROCEDURE teleport (VAR pos, old pos: position);
      VAR other: 1..2;
   BEGIN
      WITH port [1].entrance DO
         IF (pos.x = x) AND (pos.y = y) THEN
            other := 2
         ELSE
            other := 1;
      pos := port [other].exit;
      old pos := port [other].entrance
   END; { teleport }

   PROCEDURE move ghost;
   BEGIN
      ghost old pos [this ghost] := ghost pos [this ghost];
      WITH ghost old pos [this ghost] DO
         draw square (ghost old pos [this ghost], grid [y, x]);
      ghost pos [this ghost] := choice;
      WITH ghost pos [this ghost] DO
         IF grid [y, x] = terminal THEN
            teleport (ghost pos [this ghost], ghost old pos [this ghost]);
      draw square (ghost pos [this ghost], ghost)
   END; { move ghost }

   PROCEDURE move gulper;

      PROCEDURE ghost dead;
      BEGIN
         score := score + ghost value;
         GotoXY (17, 22);
         write ('SCORE = ', score: 6);
         draw square (ghost pos [i], gulper);
         ghost pos [i] := den pos [random (4) + 1];
         ghost old pos [i] := ghost pos [i];
         draw square (ghost pos [i], ghost)
      END; { check ghost dead }

      PROCEDURE energize;
         VAR chase time: INTEGER;

         PROCEDURE choose ghosts move;

            PROCEDURE check valid square;
            BEGIN
               WITH ghost pos [this ghost] DO BEGIN
                  IF (x <> ghost old pos [this ghost].x)
                  OR (y <> ghost old pos [this ghost].y) THEN
                     IF NOT (grid [y, x] IN [wall, den]) THEN BEGIN
                        distance := hyp sqr [ghost pos [this ghost]];
                        IF distance > longest THEN BEGIN
                           longest := distance;
                           choice := ghost pos [this ghost]
                        END
                     END
               END
            END; {check valid square}

         BEGIN
            longest := -1;
            WITH ghost pos [this ghost] DO BEGIN
               y := y - 1;
               check valid square;
               y := y + 2;
               check valid square;
               x := x - 1; y := y - 1;
               check valid square;
               x := x + 2;
               check valid square;
               x := x - 1
            END
         END; { choose ghosts move }

      BEGIN
         grid [gulper pos.y, gulper pos.x] := blank;
         draw square (gulper old pos, blank);
         draw square (gulper pos, gulper);
         chase time := 100;
         WHILE (chase time > 0) AND NOT dead DO BEGIN
            gulper := super gulper;
            IF chase time > 10 THEN Sound (2000);
            NoSound;
            FOR i := 1 TO wait time DO
```

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```
                IF KeyPressed THEN move_gulper;
             choose_ghosts_move;
             move_ghost;
             WITH ghost_pos [this_ghost] DO
             IF (x = gulper_pos.x) AND (y = gulper_pos.y) THEN
                ghost_dead;
             this_ghost := this_ghost MOD no_ghosts + 1;
             chase_time := chase_time - 1
          END;
          gulper := normal_gulper;
          draw_square (gulper_old_pos, blank);
          draw_square (gulper_pos, gulper)
       END; { energize }

    BEGIN
       read (KBD, key);
       IF key IN ['2', '4', '6', '8', 'H', 'K', 'M', 'P'] THEN BEGIN
          gulper_old_pos := gulper_pos;
          WITH gulper_pos DO BEGIN
             CASE key of
                '2', 'P': y := y + 1;
                '4', 'K': x := x - 1;
                '6', 'M': x := x + 1;
                '8', 'H': y := y - 1
             END;
             square := grid [y, x]
          END;
          IF square IN [wall, den] THEN
             gulper_pos := gulper_old_pos
          ELSE BEGIN
             draw_square (gulper_old_pos, blank);
             FOR i := 1 TO no_ghosts DO
                WITH ghost_pos [i] DO
                   IF (x = gulper_pos.x) AND (y = gulper_pos.y) THEN
                      IF gulper = normal_gulper THEN
                         dead := true
                      ELSE
                         ghost_dead;
             IF NOT dead THEN BEGIN
                IF square = dot THEN BEGIN
                   score := score + dot_value;
                   GotoXY (17, 22);
                   write ('SCORE = ', score: 6);
                   num_dots := num_dots - 1
                   END
                ELSE
                   IF square = terminal THEN
                      IF random (4) = 0 THEN
                         dead := true
                      ELSE
                         teleport (gulper_pos, gulper_old_pos)
                   ELSE
                      IF square = bonus THEN BEGIN
                         score := score + bonus_value;
                         GotoXY (17, 22);
                         write ('SCORE = ', score: 6)

                         END
                      ELSE
                         IF square = power_pill THEN energize
             END;
             IF NOT dead THEN BEGIN

               grid [gulper_pos.y, gulper_pos.x] := blank;
               draw_square (gulper_pos, gulper)
             END
          END
       END
    END; { move_gulper }

    PROCEDURE choose_ghosts_move;

       PROCEDURE check_valid_square;
         VAR
            allowed: BOOLEAN;
       BEGIN
          WITH ghost_pos [this_ghost] DO BEGIN
             IF (x <> ghost_old_pos [this_ghost].x)
             OR (y <> ghost_old_pos [this_ghost].y) THEN BEGIN
                allowed := true;
                FOR i := 1 TO no_ghosts DO
                   IF i <> this_ghost THEN
                      allowed := allowed AND
                      NOT ((x = ghost_pos [i].x) AND (y = ghost_pos [i].y));
                IF allowed THEN
                   IF NOT (grid [y, x] IN [wall, den]) THEN BEGIN
                      number_directions := number_directions + 1;
                      distance := hyp_sqr (ghost_pos [this_ghost]);
                      IF distance < shortest THEN BEGIN
                         shortest := distance;
                         choice := ghost_pos [this_ghost]
                      END
                   END
             END
          END
       END; {check_valid_square}

    BEGIN
       shortest := maxint;
       number_directions := 0;
       WITH ghost_pos [this_ghost] DO BEGIN
          y := y - 1;
          check_valid_square;
          y := y + 2;
          check_valid_square;
          x := x - 1; y := y - 1;
          check_valid_square;
          x := x + 2;
          check_valid_square;
          x := x - 1
       END;
       IF number_directions <> 1 THEN
          IF hyp_sqr (ghost_old_pos [this_ghost]) < shortest THEN
             choice := ghost_old_pos [this_ghost]
    END; { choose_ghosts_move }

    PROCEDURE regulate_bonuses;
    BEGIN
        IF NOT bonus_on THEN BEGIN
           IF bonuses > 0 THEN
              IF random (200) = 0 THEN BEGIN
                 bonus_on := true;
                 this_bonus_pos := bonus_pos [random (4) + 1];
                 grid [this_bonus_pos.y, this_bonus_pos.x] := bonus;
                 draw_square (this_bonus_pos, bonus);
                 bonuses := bonuses - 1;
                 GotoXY (35, 22);
                 write ('BONUSES LEFT:');
                 FOR i := 1 TO bonuses DO
                    write (' ', bonus);
                 write ('      ');
                 Sound (1000);
                 Delay (100);
                 NoSound;
                 bonus_life := 50
              END
           END
        ELSE BEGIN
           bonus_life := bonus_life - 1;
           IF bonus_life = 0 THEN BEGIN
              bonus_on := false;
              grid [this_bonus_pos.y, this_bonus_pos.x] := blank;
              draw_square (this_bonus_pos, blank)
           END
        END;
    END; { regulate_bonuses }

BEGIN
    assign_values;
    title_page;
    REPEAT
       score := 0;
       lives := 3;
       wait_time := 800;
       make_grid;
       bonuses := 3;
       completion_bonus := max_comp_bonus;
```

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```
        NoSound;
        give_instructions;
        WHILE lives > 0 DO BEGIN
           write ('PRESS <RETURN> TO CONTINUE ');
           readln (KBD);
           ClrScr;
           gulper_pos.x := 24;
           gulper_pos.y :=  5;
           gulper := normal_gulper;
           FOR i := 1 TO no_ghosts DO BEGIN
              ghost_pos [i] := den_pos [random (4) + 1];
              ghost_old_pos [i] := ghost_pos [i]
           END;
           gulper_old_pos := gulper_pos;

           draw_grid;
           GotoXY (17, 22);
          write ('SCORE = ', score: 6);
          write ('     BONUSES LEFT:');
          FOR i := 1 TO bonuses DO
             write (' ', bonus);
          GotoXY (60, 22);
          FOR i := 1 TO lives - 1 DO
             write (' ', gulper);
          this_ghost := 1;
          dead := false;
          moves_count := acceleration;
          REPEAT
          UNTIL KeyPressed;
          REPEAT

             regulate_bonuses;
             FOR i := 1 TO wait_time DO
                IF KeyPressed AND NOT dead THEN move_gulper;
             choose_ghosts_move;
             move_ghost;
             WITH ghost_pos [this_ghost] DO
                IF (x = gulper_pos.x) AND (y = gulper_pos.y) THEN
                   dead := true;
             this_ghost := this_ghost MOD no_ghosts + 1;
             moves_count := moves_count - 1;
             IF moves_count = 0 THEN BEGIN
                moves_count := acceleration;
                IF wait_time > fastest THEN
                   wait_time := wait_time - 1;
                IF completion_bonus > 0 THEN
                   completion_bonus := completion_bonus - 1
             END



          UNTIL dead OR (num_dots = 0);
          IF dead THEN BEGIN
             lives := lives - 1;
             Sound (200);
             Delay (500);
             NoSound;
             GotoXY (15, 24);
             write ('YOU HAVE LOST A LIFE    ')
             END
          ELSE BEGIN
             score := score + completion_bonus;
             bonuses := 3;
             completion_bonus := max_comp_bonus;
             make_grid;
             GotoXY (12, 24);
             write ('YOU HAVE EATEN ALL THE DOTS  ')
          END


        END;
        GotoXY (15, 24);
        write ('G A M E    O V E R    -    Do you want another game?');
        REPEAT
           read (KBD, reply);
           reply := UpCase (reply)
        UNTIL reply IN ['Y', 'N']
     UNTIL reply = 'N'
```

Detailed Directory Tip

by GG Haigh

This tip allows the user to create a file on a disk which will provide a detailed descriptive directory.

Create a file DD.BAT in the following format:

DDD
filename1 Description
filename2 Description

and so on, until all files on the disk are listed. Then, whenever a new file is added to the disk, type:

echo filename description >>ddd

then press RETURN. The description will be added to the list. Now, whenever you want a descriptive directory, type dd.

BBC Automatic Disk Menu

by Colin Brown

MICROTEX 666

This program is available electronically through Microtex 666's software downloading service. It is accessed through Viatel page *66637#.

This program has been written for a BBC Micro or an Acorn Electron with a disk filing system (DFS). The only incompatibility is that users with Basic 1 will have to replace OSCLI("DRIVE"+drv$) statements by call$="DRIVE"+drv$:CALL&C00,call$.

The program automatically displays all files on the disk or all files in a directory onscreen. When one of these is chosen, the program decides whether to CHAIN or *RUN the file and does so. The '+' directory has been set aside so that all programs in it are CHAINed.

Other options available are toggling sound on/off, menus for other disks can be displayed, a print-out can be made, and a page of comprehensive information about the disk can be displayed.

After typing the program into the computer, save it to disk before trying it. Make sure it runs correctly by trying all the commands in menu and disk status mode. To use the program, CHAIN it, although it's more useful to set it up to auto-boot by making a !BOOT file; this should consist of MODE7 and CHAIN"MENU". The boot-up option should then be changed to *EXEC using *OPT 4,3.

Do not select a non-existent drive or try to use the printer when it isn't there — this will crash the program.

The files shown in the menu are controlled by the variable dir% in line 110. This should contain the ASCII value of the directory from which the files are required to be displayed. So, to display files from the directory 'A', dir% should be changed from dir%=ASC"&", as in the listing, to dir%=ASC"A". If all files from all directories on the disk are required to be displayed, alter dir%=ASC"&" to dir%=0.

The controls for the program are as follows:

TAB — toggle between menu and disk status.
<CTRL>S — toggle sound on/off.
<CTRL>P — output screen to printer.
0 to 3 — change to corresponding drive.

On the menu page, press the letters beside the filenames to load the corresponding files.

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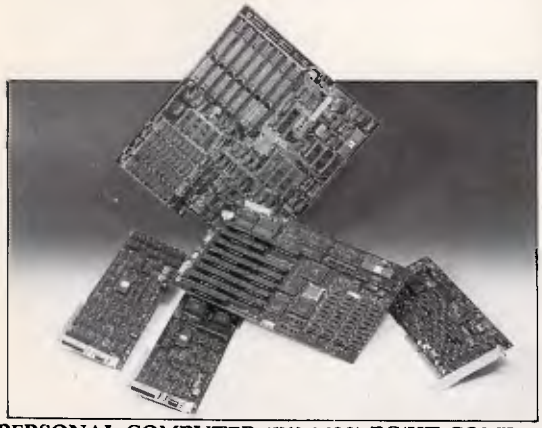

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```
  10REM Atomatic Disc Menu
  20REM for Acorn Electron and
  30REM BBC Microcomputers with a DFS
  40REM :
  50REM by COLIN BROWN
  60REM 18th June 1986
  70:
  80ONERROR PROCFAULT
  90MODE7
 100VDU23;8202;0;0;0;
 110dir%=ASC"&"
 120DIMfiles$(31),fcb% 10
 130osgbpb=&FFD1:osword=&FFF1:osbyte=&FFF4
 140dir$="":dir2$=""
 150drv$="0":sound$="on "
 160status%=FALSE:print% 0:option%=0
 170sect1%=&4000:sect2%=&4100
 180*FX4,2
 190*FX11
 200*FX210,0
 210OSCLI("DRIVE "+drv$)
 220PROCINITIATE
 230PROCCONTROL
 240END
 250:
 260DEFPROCCONTROL
 270CLS
 280IFoption%=9 ANDstatus%=TRUE status%=FALSE ELSE IFoption%=9 ANDstatus%=FALSE
status%=TRUE
 290IFstatus%=TRUE PROCSTATUS ELSE PROCDISPLAY
 300PROCENTER
 310PRDCLOAD
 320ENDPROC
 330:
 340DEFPROCINITIATE
 350REM   GET DISC SECTOR INFORMATION
 360?fcb%=&FF:fcb%!1=sect1%:fcb%?5=3:fcb%?6=&53:fcb%?7=0:fcb%?8=0:fcb%?9=&22
 370A%=&7F:X%=fcb% MOD256:Y%=fcb% DIV256
 380CALLosword
 390IFfcb%?10<>0 PROCFAULT
 400REM   GET CURRENT DIRECTORY
 410DIM fcb% 10
 420?fcb%=&FF:fcb%!1=&4300:fcb%!5=&F:fcb%!9=0
 430A%=6:X%=fcb% MOD256:Y%=fcb% DIV256
 440CALLosgbpb
 450dir$=CHR$(?&4303)
 460REM   GET DISC SURFACE TITLE
 470title$="":loop%=0
 480REPEAT
 490chr%=ASC(CHR$(?(sect1%+loop%)))
 500IFchr%>31 ANDchr%<127 title$=title$+CHR$(chr%)
 510loop%=loop%+1
 520IFloop%=8 loop%=256
 530chr%=ASC(CHR$(?(sect1%+loop%)))
 540UNTILloop%=260 ORchr%>126 ORchr%<32
 550REM   GET FILENAMES
 560total%=0:loop%=1
 570REPEAT
 580files$(loop%)=""
 590chr%=sect1%+(loop%*8)
 600IFchr%?7=dir% ORchr%?7=dir%+&80 ORchr%?7=&2B ORchr%?7=&AB ORdir%=0 total%=t
otal%+1:FORcount%=0TO6:files$(total%)=files$(total%)+CHR$(?(chr%+count%)):NEXT
 610loop%=loop%+1
 620UNTILloop%=32 OR?(chr%+8)=0
 630ENDPROC
 640:
 650DEFPROCDISPLAY
 660xaxis%=1:yaxis%=4
 670IFASC(title$)<33 title$="No disc title !"
 680FOR loop%=0TO1
 690PRINTTAB(0,loop%);CHR$129;CHR$157;TAB(140-LEN(title$))/2-1,)loop%);CHR$1));C
HR$1+1;tit)e$
 700NEXT
 710REM   FORMAT MENU SCREEN
 720FORloop%=1TOtotal%
 730IFtotal%<>0 PRINTTAB(xaxis%,yaxis%);CHR$130;CHR$()oop%+64);")";CHR$131;file
s$(loop%)
 740xaxis%=xaxis%+13
 750IFloop% MOD 3=0 ANDloop%<>total% xaxis%=1:yaxis%=yaxis%+1
 760NEXT
 770IFtotal%=0 PRINTTAB(6,yaxis%);CHR$131;CHR$141;"No loader files present !",1
AB(6,yaxis%+1);CHR$131:CHR$141:"No loader files present !":yaxis%=yaxis%+1
 780PRINTTAB(0,yaxis%+2);CHR$129;CHR$157;TAB(27);CHR$131;"Drive ";drv$
 790PRINTTAB(0,yaxis%+7);CHR$129;CHR$157;CHR$131;"<CTRL>S Sound on/off";TAB(29)
;"0-3 Drive"
 800PRINTTAB(0,yaxis%+8);CHR$129;CHR$157;TAB(2,yaxis%+8);CHR$131;"<CTRL>P Print
";TAB(21);"<TAB> Disc status";
 810PRINTTAB(0,yaxis%+4);CHR$131;CHR$141;"Enter Option...";TAB(0,yaxis%+5);CHR$
131;CHR$141;"Enter Option...";
 820ENDPROC
 830:
 840DEFPROCENTER
 850IFstatus%=TRUE PRINTTAB(1,20);CHR$131;"Sound ";sound$ ELSE PRINTTAB(4,yaxis
%+2);CHR$131:"Sound ";sound$
 860*FX15,0
 870option%=GET
 880IFoption%=19 ANDsound$="on " sound$="off" ELSE IFoption%=19 ANDsound$="off"
 sound$="on "
 890IFsound$="on " A%=210:X%=0:CALLosbyte ELSE IFsound$="off" A%=210:X%=1:CALLo
sbyte
 900IFoption%=9 PROCCONTROL
 910IFoption%=16 PROCPRINT
 920IFoption%>47 ANDoption%<52 drv$=CHR$(option%):OSCLI("DRIVE "+drv$):PROCINIT
IATE:PROCCONTROL
 930IFstatus%=TRUE ORoption%<65 ORoption%>(64+total%) PROCENTER
 940ENDPROC
 950:
 960DEFPROCSTATUS
 970status%=TRUE:comp1%=0:comp2%=0
 980files%=sect2%+sect2%?5
 990REM   FIND MEMORY AFTER COMPACTION
1000REPEAT
1010IF?(files%+4)<>0 comp1%=comp1%+&100
1020comp1%=comp1%+256*?(files%+5)+256*16*(?(files%+6) AND &30)
1030files%=files%-8
1040UNTILfiles%=sect2% ORsect2%?5=0
1050comp1%=comp1%+&200
1060comp2%=(sect2%?&E AND 3)*256+sect2%?&F+(sect2%?&E AND &30)*16+sect2%?&D-(se
ct2%?&C<>0)
1070bootup%=sect2%?6 DIV 16
1080sectors%=256*(sect2%?6-bootup%*16)+sect2%?7
1090discmem%=sectors%-comp2%
1100IFsect2%?5>0 comp2%=comp2%-(comp1% DIV 256) ELSEcomp2%=0
1110IFprint%=FALSE PRINTTAB(0,0);CHR$129;CHR$157;TAB(13,0);CHR$131;CHR$141;"Dis
c Status":TAB(0,1);CHR$129;CHR$157;TAB(13,1);CHR$131;CHR$141;"Disc Status"
1120IFsectors%=&190 RESTORE1830
1130IFsectors%=&320 RESTORE1840
1140IFsectors%>&190 ANDsectors%<&320 RESTORE1850
1150IFsectors%>&320 RESTORE1860
1160READ dsize$
1170IFbootup%=0 RESTORE1870
1180IFbootup%=1 RESTORE1880
1190IFbootup%=2 RESTORE1890
1200IFbootup%=3 RESTORE1900
1210READ boot$
1220IFASC(title$)<33 title$="No disc title !"
1230PRINTTAB(1,3);CHR$131;"Drive ";drv$
1240PRINTTAB(1,4);CHR$131;"Title : ";title$
1250PRINTTAB(1,5);CHR$131;"Directory ";dir$
1260IFdir%=0 dir2$="all directories" ELSE dir2$=CHR$dir%+" directory"
1270PRINTTAB(1,5);CHR$131;"Files displayed from ";dir2$
1280PRINTTAB(1,6);CHR$131;dsize$
1290PRINTTAB(1,7);CHR$131;"Formatted for &";~sectors%;" (";sectors%;" DEC) sect
ors"
1300PRINTTAB(1,8);CHR$131;"BOOT-UP option : *OPT4,";bootup%;" ";boot$
1310PRINTTAB(1,9);CHR$131;~sect2%?4;" Write operations"
1320PRINTTAB(1,10);CHR$131;total%;" Loader files"
1330PRINTTAB(1,11);CHR$131;?&4105 DIV 8;" Files altogether"
1340PRINTTAB(1,12);CHR$131;"Free disc memory before compaction:-"
1350PRINTTAB(1,13);CHR$131;" sectors  : ";discmem%;" (DEC)";TAB(27);"&";~discme
m%;" (HEX)"
1360PRINTTAB(1,14);CHR$131;" bytes    : ";discmem%*256;" (DEC)";TAB(27);"&";~di
scmem%*256;" (HEX)"
1370PRINTTAB(1,15);CHR$131;"Memory gained after compaction:-"
1380PRINTTAB(1,16);CHR$131;" sectors  : ";comp2%;" (DEC)";TAB(27);"&";~comp2%;"
(HEX)"
1390PRINTTAB(1,17);CHR$131;" bytes    : ";comp2%*256;" (DEC)";TAB(27);"&";~comp
2%*256;" (HEX)"
1400PRINTTAB(1,18);CHR$131;"Total secs: ";discmem%+comp2%;" (DEC)";TAB(27);"&";
discmem%+comp2%;" (HEX)"
1410PRINTTAB(1,19);CHR$131;"Total byts: ";256*(discmem%+comp2%);" (DEC)";TAB(27
);"&";~256*(discmem%+comp2%);" (HEX)"
1420IFprint%=TRUE ENDPROC
1430PRINTTAB(8,21);CHR$130;"<CTRL> S   Sound on/off"
1440PRINTTAB(8,22);CHR$130;"<CTRL> P   Print"
1450PRINTTAB(8,23);CHR$130;"<TAB>      Return to menu"
1460PRINTTAB(8,24);CHR$130;"0 to 3     Change drive";
```

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```
1470ENDPROC
1480:
1490DEFPROCLOAD
1500count%=0:loop%=0:fname$=""
1510REPEAT
1520loop%=loop%+1
1530REM   FIND HOW TO LOAD FILE
1540IFdir%<0 AND?(sect1%+7+(loop%*8))=dir% OR?(sect1%+7+(loop%*8))=dir%+&80 OR?
(sect1%+7+(loop%*8))=&2B OR?(sect1%+7+(loop%*8))=&AB count%=count%+1
1550UNTILcount%=option%-64 ORdir%=0
1560IFdir%=0 loop%=option%-64
1570method%=?(sect2%+6+(loop%*8))
1580dir2%=?(sect1%+7+(loop%*8))
1590fname$=CHR$(dir2%+"."+files$(option%-64)
1600*FX4,0
1610*FX11,50
1620REM   LOAD CHOSEN FILE
1630IFmethod%=&BF ORdir2%=&2B ORdir2%=&AB PRINTTAB(17,yaxis%+4);CHR$134;CHR$141
;"CHAINing";CHR$130;CHR$(option%);")";CHR$131;fname$:TAB(17,yaxis%+5);CHR$134;CH
R$141;"CHAINing";CHR$130;CHR$(option%);")";CHR$131;fname$:CHAINfname$:END
1640PRINTTAB(17,yaxis%+4);CHR$134;CHR$141;"*RUNing";CHR$130;CHR$(option%);"(";CH
R$131;fname$:TAB(17,yaxis%+5);CHR$134;CHR$141;"*RUNing";CHR$130;CHR$(option%);")
";CHR$131:fname$:OSCLI("RUN "+fname$:END
1650ENDPROC
1660:
1670DEFPROCPRINT
1680print%=TRUE
1690VDU2,1,27,1,69,1,27,1,71,1,14,3
1700IFstatus%=TRUE VDU2,21:PRINT"Disc Status"STRING$(47,"-"):PROCSTATUS:VDU13,
3:print%=FALSE:PROCCONTROL
1710*FX3,10
1720PRINT;title$
1730PRINT;STRING$(47," ")
1740FORloop%=1TOtot%
1750PRINT;files$(loop%);"   ";
1760IFloop%/4=0 PRINT
1770NEXT
1780VDU13,13
1790*FX3,0
1800print%=FALSE
1810ENDPROC
1820:
1830DATA"Single density, 40 track"
1840DATA"Single density, 80 track"
1850DATA"Double density, 40 track"
1860DATA"Double density, 80 track"
1870DATA"(option of()"
1880DATA"(*RUN)"
1890DATA"(*LOAD)"
1900DATA"(*EXEC)"
1910:
1920DEFPROCFAULT
1930ONERRUROFF
1940*FX4,0
1950*FX11,50
1960*FX15,0
1970IFfcb%?10<>0 PRINT:"Disk fault ";fcb%?10
1980REPORT:PRINT;" at line ";ERL
1990END
2000ENDPROC
```

Commodore 64 Graphics Plotter

by Simon Cook

MICROTEX 666

This program is available electronically through Microtex 666's software downloading service. It is accessed through Viatel page *66637#

This program provides a way of plotting points of 4x4 pixels in size anywhere onscreen, allowing point plotting of up to 80 by 50. The routine is in machine code and very fast.

To call the plot routine from machine code, the x and y coordinates must be loaded into the x and y registers, and stored in locations $00fb and $00fc respectively.

To set the plot type, a number between 0 and 2 must be loaded into the accumulator and stored in location $0002. The routine is then called by JSR $9ecd. For those wishing to call the routine from Basic, the instructions are in the Basic listing.

```
10 REM------MACHINE CODE DATA------
20 DATA138,72,152,24,106,176,22,198,252,104,24,106,176,8,198,251,169,4,133
30 DATA2,144,24,169,8,133,2,24,144,17,104,24,106,176,8,198,251,169,1,133
40 DATA2,144,4,169,2,133,2,216,169,0,141,54,3,141,55,3,141,56,3,169,8,141,57
50 DATA3,169,40,141,52,3,165,252,74,141,53,3,110,52,3,144,19,24,173,53,3,109
60 DATA55,3,141,55,3,173,54,3,109,56,3,141,56,3,14,53,3,46,54,3,206,57,3
70 DATA208,221,173,55,3,133,253,173,56,3,133,254,169,4,24,101,254,133,254
80 DATA165,251,106,234,24,101,253,144,2,230,254,133,253,162,0,161,253,141,58
90 DATA3,162,16,189,187,158,205,58,3,240,5,202,208,245,162,0,138,32,253,158
110 DATA234,170,189,187,158,162,0,129,253,165,254,24,105,212,133,254,173,134
120 DATA2,129,253,96,32,124,126,226,108,225,127,251,123,255,97,236,98,254,252
130 DATA160,208,1,165,2,10,10,109,219,158,141,219,158,120,160,4,185,240,158
140 DATA153,161,158,136,208,247,169,240,141,219,158,166,251,164,252,32,0,158
150 DATA88,96,32,253,158,234,138,138,5,2,138,138,69,2,72,165,2,73,15,133,2
160 DATA104,37,2,96,162,255,160,157,24,32,153,255,96
2000 REM-------POKE IN DATA--------
2010 FOR LOC=40448 TO 40448 + 272
2020 READ D:L=L+D:POKELOC,D:NEXT
2030 IF L <> 32072 THEN PRINT"DATA FAULT";L;" SHOULD BE 32072":END
2035 SYS 40712:REM MOVE TOP OF MEMORY DOWN TO PROTECT PLOT ROUTINE
2040 REM------DEMONSTRATION-------
2045 PRINT"PLOT INSTALLED OK, DO YOU WANT A DEMO";:INPUT A$:IF A$<>"Y"THEN END
2046 PRINT"";
2050 FOR LOOP =1 TO 1000
2060 X=INT(RND(1)*79)+1:REM RANDOM X VALUE IN RANGE  0<X<81
2070 Y=INT(RND(1)*49)+1:REM RANDOM Y VALUE IN RANGE  0<Y<51
2080 POKE 251,X:REM SET X VALUE FOR PLOT
2090 POKE 252,Y:REM SET Y VALUE FOR PLOT
2100 POKE 2,2:REM SET TOGGLE STATUS
2105 SYS 40653:REM CALL PLOT ROUTINE
2110 NEXT
2120 END
2200 REM-------INSTRUCTIONS-------
2210 REM PLACE X LOCATION IN LOC 251
2220 REM PLACE Y LOCATION IN LOC 252
2230 REM PLACE PLOT STATUS IN LOC 2
2240 REM PLOT STATUS 0--ERASE POINT
2250 REM             1--SET POINT
2260 REM             2--TOGGLE POINT
2270 REM TO PLOT SYS 40653
2280 REM YOU MUST SYS 40712 TO PROTECT
2290 REM THE PLOT ROUTINE FROM CORRUPTION
2300 REM BY BASIC VARIBLES
```

```
.;  9E00 8A       TXA
.;  9E01 48       PHA
.;  9E02 98       TYA
.;  9E03 18       CLC
.;  9E04 6A       ROR
.;  9E05 B0 16    BCS $9E1D
.;  9E07 C6 FC    DEC $FC
.;  9E09 68       PLA
.;  9E0A 18       CLC
.;  9E0B 6A       RDR
.;  9E0C B0 08    BCS $9E16
.;  9E0E C6 FB    DEC $FB
.;  9E10 A9 04    LDA #$04
.;  9E12 85 02    STA $02
.;  9E14 90 18    BCC $9E2E
.;  9E16 A9 08    LDA #$08
.;  9E18 85 02    STA $02
.;  9E1A 18       CLC
.;  9E1B 90 11    BCC $9E2E
.;  9E1D 68       PLA
.;  9E1E 18       CLC
.;  9E1F 6A       ROR
.;  9E20 B0 08    BCS $9E2A
.;  9E22 C6 FB    DEC $FB
.;  9E24 A9 01    LDA #$01
.;  9E26 85 02    STA $02
.;  9E28 90 04    BCC $9E2E
.;  9E2A A9 02    LDA #$02
.;  9E2C 85 02    STA $02
.;  9E2E D8       CLD
.;  9E2F A9 00    LDA #$00
.;  9E31 8D 36 03 STA $0336
.;  9E34 8D 37 03 STA $0337
.;  9E37 8D 38 03 STA $0338
.;  9E3A A9 08    LDA #$08
.;  9E3C 8D 39 03 STA $0339
.;  9E3F A9 28    LDA #$2B
.;  9E41 8D 34 03 STA $0334
.;  9E44 A5 FC    LDA $FC
.;  9E46 4A       LSR
.;  9E47 8D 35 03 STA $0335
.;  9E4A 6E 34 03 ROR $0334
.;  9E4D 90 13    BCC $9E62
.;  9E4F 18       CLC
.;  9E50 AD 35 03 LDA $0335
.;  9E53 6D 37 03 ADC $0337
.;  9E56 8D 37 03 STA $0337
.;  9E59 AD 36 03 LDA $0336
.;  9E5C 6D 38 03 ADC $0338
.;  9E5F 8D 38 03 STA $0338
.;  9E62 0E 35 03 ASL $0335
.;  9E65 2E 36 03 ROL $0336
.;  9E68 CE 39 03 DEC $0339
.;  9E6B D0 DD    BNE $9E4A
.;  9E6D AD 37 03 LDA $0337
.;  9E70 85 FD    STA $FD
.;  9E72 AD 38 03 LDA $0338
.;  9E75 85 FE    STA $FE
.;  9E77 A9 04    LDA #$04
.;  9E79 18       CLC
.;  9E7A 65 FE    ADC $FE
.;  9E7C 85 FE    STA $FE
.;  9E7E A5 FB    LDA $FB
.;  9E80 6A       ROR
.;  9E81 EA       NOP
.;  9E82 18       CLC
.;  9E83 65 FD    ADC $FD
.;  9E85 90 02    BCC $9E89
.;  9E87 E6 FE    INC $FE
.;  9E89 85 FD    STA $FD
.;  9E8B A2 00    LDX #$00
.;  9E8D A1 FD    LDA ($FD,X)
.;  9E8F 8D 3A 03 STA $033A
.;  9E92 A2 10    LDX #$10
.;  9E94 BD BB 9E LDA $9EBB,X
.;  9E97 CD 3A 03 CMP $033A
.;  9E9A F0 05    BEQ $9EA1
.;  9E9C CA       DEX
.;  9E9D D0 F5    BNE $9E94
.;  9E9F A2 00    LDX #$00
.;  9EA1 8A       TXA
.;  9EA2 20 FD 9E JSR $9EFD
.;  9EA5 EA       NOP
```

```
..  9EA6 AA       TAX
..  9EA7 BD BB 9E LDA $9EBB,X
..  9EAA A2 00    LDX #$00
..  9EAC 81 FD    STA (0FD,X)
..  9EAE A5 FE    LDA $FE
..  9EB0 18       CLC
..  9EB1 69 D4    ADC #$D4
..  9EB3 85 FE    STA $FE
..  9EB5 AD B6 02 LDA $02B6
..  9EB8 81 FD    STA ($FD,X)
..  9EBA 60       RTB
..  9EBB 20 7C 7E JSR $7E7C
..  9EBE E2       ???
..  9EBF 6C E1 7F JMP ($7FE1)
..  9EC2 FB       ???
..  9EC3 7B       ???
..  9EC4 FF       ???
..  9EC5 61 EC    ADC ($EC,X)
..  9EC7 62       ???
..  9EC8 FE FC A0 INC $A0FC,X
..  9ECB D0 01    BNE $9ECE
..  9ECD A5 02    LDA $02
..  9ECF 0A       ASL
..  9ED0 0A       ASL
..  9ED1 6D DB 9E ADC $9EDB
..  9ED4 8D DB 9E STA $9EDB
..  9ED7 78       SEI
..  9ED8 A0 04    LDY #$04
..  9EDA B9 F0 9E LDA $9EF0,Y
..  9EDD 99 A1 9E STA $9EA1,Y
..  9EE0 88       DEY
..  9EE1 D0 F7    BNE $9EDA
..  9EE3 A9 F0    LDA #$F0
..  9EE5 8D DB 9E STA $9EDB
..  9EE8 A6 FB    LDX $FB
..  9EEA A4 FC    LDY $FC
..  9EEC 20 00 9E JSR $9E00
..  9EEF 58       CLI
..  9EF0 60       RTS
..  9EF1 20 FD 9E JSR $9EFD
..  9EF4 FA       NOP
..  9EF5 8A       TXA
..  9EF6 8A       TXA
..  9EF7 05 02    ORA $02
..  9EF9 8A       TXA
..  9EFA 8A       TXA
..  9EFB 45 02    EOR $02
..  9EFD 48       PHA
..  9EFE A5 02    LDA $02
..  9F00 49 0F    EOR #$0F
..  9F02 85 02    STA $02
..  9F04 68       PLA
..  9F05 25 02    AND $02
..  9F07 60       RTS
..  9F08 A2 FF    LDX #$FF
..  9F0A A0 9D    LDY #$9D
..  9F0C 18       CLC
..  9F0D 20 99 FF JSR $FF99
..  9F10 60       RTS
```

Spectrum Procedures

by David Hales

This program for the ZX Spectrum requires an Interface 1; it makes use of the Interface 1's ability to add new commands to Basic. The program adds a procedure command, similar to that on the BBC Micro. The command makes structured programming easier, since programs can be broken down into modules more easily. The main difference between GOSUB and procedures is that procedures are called by name and allow expressions to be passed to them.

Listing one is for an assembler; listing two if you only have access to Basic. After running listing two, the code will be saved to tape or microdrive. The code starts at address 64500 and is 507 bytes long, so to use the new commands, first type CLEAR 64499 and then load the code back in off tape. When the code is in memory, enable the new commands by typing CLEAR £:RANDOMIZE USR 64500. The routine is not relocatable, so can only be used with the 48k machine.

*PROC and *DEF should be followed by a name identifying the procedure. Each name can be up to 19 characters long and must terminate in a comma. Any characters can be used in a name (although spaces and control characters are ignored) except colons and commas.

Here is an example program:

```
10 RANDOMIZE USR 64500
20 *PROC BELL,
30 STOP
50 *DEFPROC BELL
60 BEEP 1,0
70 *ENDPROC
```

The following program illustrates a procedure called BELL which has no arguments. When the program is run, the computer will beep, then stop. Here is a more complex example:

```
10 RANDOMIZE USR 64500
20 *PROC DOKE,65534,9999
30 STOP
40 *DEFPROC DOKE,ADDRESS
  ,VALUE
50 LET HI=INT (VALUE/256)
60 LET LO=VALUE-HI*256
70 POKE ADDRESS,LO
80 POKE ADDRES+1,HI
90 *ENDPROC
```

The procedure DOKE allows two single-byte Z80 values to be POKED into memory — this can be very useful for messing about with the system variables. Listing three is a thorough demonstration of how the procedure command can be used.

There are a number of error messages which you might encounter while using the commands. These are:

Nonsense in Basic — this will occur if there aren't enough expressions in a *PROC statement, or if one of them is of the wrong type — numeric instead of string, for example.

Parameter error — there are too many expressions in a *PROC statement.

FN without DEF — a *PROC has been called without being defined.

No room for line — there are too many nested procedures. The routine allows up to 150 nested procedures.

RETURN without GOSUB — an *ENDPROC is encountered before a *PROC call.

LISTING 1

```
;SPECTRUM PROCEDURES By David Hales
;
MAXIMUM  EQU 150          ;Maximum number of nested procs
PNAME    EQU WSSTART      ;name of PROC being exicuted
VLADD    EQU WSSTART+20   ;Variable List Address (DEF line)
ELADD    EQU WSSTART+22   ;Expression List Add. (PROC line)
SAP      EQU WSSTART+24   ;Sack Address Pointer
SCOUNT   EQU WSSTART+26   ;Stack Counter
SSTART   EQU WSSTART+27   ;Stack Start
CALBAS   EQU #0010        ;various ROM routines:-
GETCHAR  EQU #0018        ;get current character in stmnt
NXTCHAR  EQU #0020        ;get next character in stmnt
STEND    EQU #05B7        ;return in syntax time
ERR6     EQU #01F0        ;invoke error in syntax time
END1     EQU #05C1        ;return in run time
CLASS01  EQU #1C1F        ;get or check next variable
SYNTAXZ  EQU #2530        ;check to see if in syntax time
VALFET1  EQU #1C56        ;get expr. and assign to variable
SCANNING EQU #24FB        ;check next expression
LOOKPROG EQU #1D86        ;look through program for a char.
TEMPPTR1 EQU #77          ;set current position in stmnt.
CHADD    EQU 23645        ;current position in stmnt.
PROG     EQU 23635        ;start of program area
ROMERR   EQU 40           ;used to invoke an error
,
;*****************
;*SET-UP ROUTINE*
;*****************
;
         ORG  64500       ;assemble to run at 64500
         DISP 41036       ;but put code at 40000
;
;ENABLE NEW COMMANDS
;
         LD   HL,23735    ;Make VECTOR interface 1 system
         LD   (HL),8      ;variable to the
         INC  HL          ;new
         LD   (HL),252    ;commands routine
;
;SET STACK VARIABLES
;
         LD   HL,SSTART   ;make Stack Address Pointer
         LD   (SAP),HL    ;point to the Stack Start
```

```
        LD   A,Ø          ;reset the
        LD   (SCOUNT),A ;Stack COUNTer
        RET
;
;**********************
;*NEW COMMAND ROUTINES*
;**********************
;
;CHECK FOR "*"
;
START   RST  CALBAS      ;Switch out interface 1 ROM and
        DEFW GETCHAR     ;Get first character of statment
        CP   42          ;is it a "*"
        JR   Z.CHCK2     ;if so. jump to CHCK2
        JP   ERR6        ;invoke syntax error
;
;CHECK FOR EACH NEW COM.
;
CHCK2   RST  CALBAS      ;switch out interface 1 rom and
        DEFW NXTCHAR     ;get next character in statment
        CP   8Ø;"P"      ;is it a "P"
        JP   Z,PROC      ;if so, jump to PROC
        CP   68;"D"      ;is it a "D"
        JP   Z,DEF       ;if so, jump to DEF
        CP   69;"E"      ;is it an "E"
        JP   Z,END       ;if so, jump to END
        JP   ERR6        ;bad command so invoke error
;
;*************
;*PROC SYNTAX*
;*************
;
PROC    LD   HL,SPROC    ;make HL point to command string
        CALL CHECK       ;check statment agains string
        JP   NZ,ERR6     ;if they do not match invoke err.
;
;GET NAME
;
        LD   HL,PNAME    ;make HL point to PNAME
        LD   D,21        ;set D to maximum length of name
NLOOP   PUSH DE          ;save registers
        PUSH HL          ;
        RST  CALBAS      ;switch out interface 1 ROM and
        DEFW NXTCHAR     ;get next character in statment
        POP  HL          ;restore registers
        POP  DE          ;
        LD   (HL),A      ;store character
        INC  HL          ;increase HL to next location
        DEC  D           ;has name exceeded 21 chars?
        JP   Z,ERR6      ;if so then invoke error
        CALL LEND        ;statment end has been reached?
        JP   Z,ERR6      ;if so then invoke error
        CP   44;","      ;end of proc name reached?
        JR   NZ,NLOOP    ;if not, jump to NLOOP and get
;                         the next character in name
;CHECK EXPRESSION LIST
;
        RST  CALBAS      ;switch out interface 1 ROM and
        DEFW NXTCHAR     ;get next character
        RST  CALBAS      ;switch out interface 1 ROM and
        DEFW SYNTAXZ     ;check to see if checking syntax
        JR   NZ,PRUN     ;if not then jump to PRUN
        RST  CALBAS      ;switch out interface 1 ROM and
        DEFW GETCHAR     ;get the present character
        CALL LEND        ;end of statment?
        CALL Z,STEND     ;if so then return
ELOOP   RST  CALBAS      ;switch out interface1 ROM and
        DEFW SCANNING    ;check expression
        CP   44;","      ;is there another expression?
        CALL NZ,STEND    ;if not then return.
        RST  CALBAS      ;switch out interface 1 ROM and
        DEFW NXTCHAR     ;get next character in statment
        JR   ELOOP       ;jump back to check next expr.
;
;**********************
;*PROC RUN TIME ACTION*
;**********************
;
PRUN    CALL MCHTEL      ;Save current position in
                         ;statment in ELADD
;PUT LINE & STAT ON STACK
;
        LD   HL,(SAP)    ;Make HL point to top of stack
        LD   A,(23621)   ;Put current line and
        LD   (HL),A      ;statment numbers
        INC  HL          ;onto the stack
        LD   A,(23622)   ;
        LD   (HL),A      ;
        INC  HL          ;
        LD   A,(23623)   ;
        INC  A           ;increase statment number so it
        LD   (HL),A      ;points to next statment
;
;FIND DEF FOR PROC
;
FIND    LD   HL,(PROG)   ;make HL point to start of prog.
FINDL   LD   E,42;"*"    ;load E with first char of DEF.
        RST  CALBAS      ;switch out interface 1 ROM and
        DEFW LOOKPROG    ;look for character in E
        JP   C,ERROR1    ;if not found jump to ERROR1
        LD   A,1         ;line number already in NEWSPPC
        SUB  D           ;calculate statment number and
        LD   (23620),A   ;put it into NSPPC
        RST  CALBAS      ;switch out interface 1 ROM and
        DEFW TEMPPTR1    ;make stmnt found current stmnt.
        RST  CALBAS      ;switch out interface 1 ROM and
        DEFW GETCHAR     ;get current character
        CP   68;"D"      ;is this stmnt a DEFPROC?
        JR   NZ,NOMATCH  ;if not then jump to NOMATCH
;
;FOUND A DEFPROC CHECK
;NAME
;
        LD   B,6         ;advance to
LLOOP   RST  CALBAS      ;proc name
        DEFW NXTCHAR     ;after
        DJNZ LLOOP       ;DEFPROC
        LD   HL,PNAME    ;make HL point to PNAME
LOOP1   PUSH HL          ;save HL
        RST  CALBAS      ;switch out interface 1 ROM and
        DEFW NXTCHAR     ;get next character in stmnt
        POP  HL          ;restore HL
        LD   D,(HL)      ;get next char of proc name
        INC  HL          ;advance HL
        CP   D           ;does proc name char match char
        JR   NZ,NOMATCH  ;in stmnt, if not jump to NOMATCH
        LD   A,D         ;has end of name been
        CP   44;","      ;reached?
        JR   NZ,LOOP1    ;if not then jump back to LOOP1
        RST  CALBAS      ;switch out interface 1 ROM and
        DEFW NXTCHAR     ;get next character in stmnt
        JR   ASIGN       ;jump forward to make assignment
;
;CURRENT LINE NO MATCH
;TRY NXT LINE IN PROG
;
NOMATCH RST  CALBAS      ;switch out interface 1 ROM and
        DEFW NXTCHAR     ;get next character in stmnt.
        CALL LEND        ;has end of stmnt been reached?
```

```
        JR   NZ,NOMATCH ;if not then jump to NOMATCH
        JR   FINDL      ;jump back to FINDL
;
;DEF FOUND, ADD IN VLADD
;
ASIGN   RST  CALBAS     ;switch out interface 1 ROM and
        DEFW GETCHAR    ;get next character
        CALL LEND       ;has end of stmnt been reached?
        JR   Z,XIT      ;if so then jump to XIT
VLOOP   RST  CALBAS     ;switch out interface 1 ROM and
        DEFW CLASS01    ;examine next variable name
        CALL MCHTVL     ;save position in stmnt
        CALL MELTCH     ;restore position in PROC line
        RST  CALBAS     ;switch out interface 1 ROM and
        DEFW VALFET1    ;assign next value to variable
        CALL MCHTEL     ;save position in PROC line
        CALL MVLTCH     ;restore position in DEF line
        RST  CALBAS     ;switch out interface 1 ROM and
        DEFW GETCHAR    ;get next character
        CP   44;","     ;is it a comma?
        JR   NZ,XIT     ;if not then jump to EXIT
        RST  CALBAS     ;switch out interface 1 ROM and
        DEFW NXTCHAR    ;get next character
        CALL MCHTVL     ;save position in DEF line
        CALL MELTCH     ;retore position in PROC line
        RST  CALBAS     ;switch out interface 1 ROM and
        DEFW NXTCHAR    ;get next character
        CALL MCHTEL     ;save position in PROC line
        CALL MVLTCH     ;retore position in DEF line
        JR   VLOOP      ;jump back to VLOOP to set next
                        ;variable
;ALL VARIABLES ASSIGNED
;ACKNOWLAGE RET LINE ON
;STACK AND RET TO BASIC
;FIRST CHECK ALL EXPS
;HAVE BEEN USED
;
XIT     CALL MELTCH     ;restore position in PROC line
        RST  CALBAS     ;switch out interface 1 ROM and
        DEFW GETCHAR    ;get current character
        CALL LEND       ;has end of stmnt been reached?
        JP   NZ,ERROR2  ;if not then jump to ERROR2
        LD   HL,(SAP)   ;Increase stack address pointer
        INC  HL         ;so that it
        INC  HL         ;includes the
        INC  HL         ;line and stmnt numbers of the
        LD   (SAP),HL   ;PROC line.
        LD   A,(SCOUNT) ;increase SCOUNT by 1 and test
        INC  A          ;that SCOUNT does not
        LD   (SCOUNT),A ;exeede the MAXIMUM
        CP   MAXIMUM+1  ;if it does then
        JP   Z,ERROR3   ;jump to ERROR3
        JP   END1       ;return
;
;****************
;*DEFPROC SYNTAX*
;****************
;
DEF     LD   HL,SDEF    ;make HL point to DEFPROC string
        CALL CHECK      ;and check it against command
        JP   NZ,ERR6    ;if does not match jump to ERR6
;
;CHECK LEN OF NAME <20
;
        LD   D,21       ;check that name
DLOOP   PUSH DE         ;does
        RST  CALBAS     ;not exceede
        DEFW NXTCHAR    ;maximum length of 20 chars
        POP  DE         ;including terminating comma.
        DEC  D          ;if it does
        JP   Z,ERR6     ;jump to ERR6
        CALL LEND       ;if there is no comma then
        JP   Z.ERR6     ;invoke syntax error
        CP   44;","
        JR   NZ,DLOOP   ;jump back to get next char.
;
;CHCK VARIABLE LIST
;
        RST CALBAS      ;switch out interface 1 ROM and
        DEFW NXTCHAR    ;get next character in stmnt
        RST  CALBAS     ;switch out interface 1 ROM and
        DEFW SYNTAXZ    ;check to see if in run time
        JR   NZ,DRUN    ;if so then jump to DRUN
        RST  CALBAS     ;switch out interface 1 ROM and
        DEFW GETCHAR    ;get next character
        CALL LEND       ;has end of stmnt been reached
        CALL Z,STEND    ;if so then return
        RST  CALBAS     ;switch out interface 1 ROM and
VLOP    DEFW CLASS01    ;check variable
        RST  CALBAS     ;switch out interface 1 ROM and
        DEFW GETCHAR    ;get current character
        CP   44;","     ;is it a comma?
        CALL NZ,STEND   ;if not then retrun
        RST  CALBAS     ;switch out interface 1 ROM and
        DEFW NXTCHAR    ;get next character
        JR   VLOP       ;jump back to check next
;                       ;expression.
;*********************
;*DEF RUN TIME ACTION*
;*********************
;
DRUN    RST  CALBAS     ;switch out interface 1 ROM and
        DEFW NXTCHAR    ;get next character
        CALL LEND       ;has end of stmnt been reached?
        JP   NZ,DRUN    ;if not then jump to DRUN
        JP   END1       ;return
;
;****************
;*ENDPROC SYNTAX*
;****************
;
END     LD   HL,SEND    ;make HL point to ENDPROC string
        CALL CHECK      ;check it against command
        JP   NZ,ERR6    ;if it does not match ivoke error
        RST  CALBAS     ;switch out interface 1 ROM and
        DEFW NXTCHAR    ;get next character
        CALL STEND      ;return
;
;*********************
;*END RUN TIME ACTION*
;*********************
;
        LD  A,(SCOUNT)  ;is there a PROC line to return
        CP  0           ;to?
        JP  Z,ERROR4    ;if not then jump to ERROR4
;
;GET LAST LINE FROM STACK
;JUMP TO THIS
;
        DEC A           ;get last line number and
        LD  (SCOUNT),A  ;stmnt numbers from the
        LD  HL,(SAP)    ;stack and load them into:
        DEC HL          ;
        LD  A,(HL)      ;
        LD  (23620),A   ;NSPPC (statment to jump to)
        DEC HL          ;
        LD  A,(HL)      ;
        LD  (23619),A   ;NEWPPC-hi  (line to jump to)
```

```
          DEC HL          ;
          LD  A,(HL)      ;
          LD  (23618),A   ;NEWPPC-lo  (line to jump to)
          LD  (SAP),HL    ;
          JP  END1        ;return
;
;MOVE CHADD TO VLADD
;
MCHTVL    LD   HL,(CHADD) ;save current positon in stmnt
          LD   (VLADD),HL ;in VLADD
          RET             ;return
;
;MOVE CHADD TO ELADD
;
MCHTEL    LD   HL,(CHADD) ;save current position in stmnt
          LD   (ELADD),HL ;in ELADD
          RET             ;return
;
;MOVE CHADD TO VLADD
;
MVLTCH    LD   HL,(VLADD) ;make current position in stmnt
          LD   (CHADD),HL ;equal to VLADD
          RET             ;return
;
;MOVE CHADD TO ELADD
;
MELTCH    LD   HL,(ELADD) ;make current position in stmnt
          LD   (CHADD),HL ;equal to ELADD
          RET             ;return
;
;CHCK NXT STR OF CHARS
;HL HOLDS ADDRESS
;
CHECK     PUSH HL         ;save address of string
          RST  CALBAS     ;switch out interface 1 ROM and
          DEFW NXTCHAR    ;get next character in stmnt
          POP  HL         ;restore address of string
          LD   D,(HL)     ;get next char in string
          INC  HL         ;advance to next character
          CP   D          ;compare string char & stmnt char
          RET  NZ         ;return if they do not march.
          LD   A,(HL)     ;get next char in string
          CP   Ø          ;is it the end of the string?
          RET  Z          ;if so then return
          JR   CHECK      ;jump back to CHECK to test next
;                          character.
;CHECK FOR STATMENT END
;SET Z-FLAG IF END FOUND
;
LEND      CP   13         ;is current character chr$(13)?
          RET  Z          ;if so then return
          CP   58         ;is it a colon ":"
          RET             ;return
;
;************************
;*ERROR MESSAGE ROUTINES*
;************************
;
;DEF NOT FOUND ERROR1
;
ERROR1    LD   (IY+ØØ),24 ;load ERR NR with error code - 1
          RST  ROMERR     ;invoke error routine
;
;TOO MANY EXPRS. ERROR2
;
ERROR2    LD   (IY+ØØ),25
          RST  ROMERR
;
;STACK FULL ERROR3
;
ERROR3    LD   (IY+ØØ),15
          RST  ROMERR
;
;END WITHOUT DEF ERROR4
;
ERROR4    LD   (IT+ØØ),6
          RST  ROMERR
;
;COMMANDS TABLE
;
SPROC     DEFM /ROC/      ;string for PROC
          DEFB Ø
SDEF      DEFM /EFPROC/   ;string for DEFPROC
          DEFB Ø
SEND      DEFM /NDPROC/   ;string for ENDPROC
          DEFB Ø
;
;SET WSSTART TO FIRST BYTE AFTER CODE
;
WSSTART   NOP
```

LISTING 2

```
 1Ø REM MACHINE CODE LOADER
 2Ø REM SPECTRUM PROCEDURES
 3Ø REM     By David Hales
 4Ø REM
1ØØ CLEAR 64499
11Ø RESTORE
12Ø PRINT AT 2,Ø;"POKING MACHINE CODE INTO MEMORY"
13Ø PRINT AT 5,1Ø; FLASH 1;"PLEASE WAIT"
19Ø LET LINE=1ØØØ
2ØØ FOR A=64500 TO 65007 STEP 15
2Ø5 LET TOTAL=Ø
21Ø FOR B=A TO A+14
22Ø READ VAL
23Ø POKE B,VAL
24Ø LET TOTAL=TOTAL+VAL
25Ø NEXT B
26Ø READ CHECK
27Ø IF TOTAL=CHECK THEN  LET LINE=LINE+1Ø: NEXT A: GO SUB 5ØØ
28Ø CLS
29Ø PRINT AT 5,3;"ERROR IN DATA AT LINE ";LINE
3ØØ STOP
31Ø PRINT "    PLEASE CHECK DATA BEFORE"
32Ø PRINT "   RUNNING THE PROGRAM AGAIN."
33Ø STOP
5ØØ REM
51Ø REM SAVE CODE
52Ø REM
53Ø CLS
55Ø PRINT "CODE NOW IN MEMORY"
56Ø PRINT
57Ø PRINT "PRESS KEY :-"
58Ø PRINT
59Ø PRINT "(1) TO SAVE TO MICRODRIVE 1"
596 PRINT "(2) TO SAVE TO TAPE"
6ØØ LET I$=INKEY$: IF I$<"1" OR I$>"2" THEN  GO TO 6ØØ
61Ø CLS
62Ø IF I$="1" THEN  SAVE *"M";1;"PROCODE"CODE 64500,507: STOP
63Ø SAVE "PROCODE"CODE 64500,507
64Ø STOP
9ØØ REM
91Ø REM M/C DATA
92Ø REM
1ØØØ DATA 33,183,92,54,8,35,54,252,33,11,254,34,8,254,62,1367
1Ø1Ø DATA Ø,5Ø,1Ø,254,2Ø1,215,24,Ø,254,42,4Ø,3,195,24Ø,1,1529
1Ø2Ø DATA 215,32,Ø,254,8Ø,2Ø2,39,252,254,68,2Ø2,27,253,254,69,2201
```

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```
1030 DATA 202,102,253,195,240,1,33,222,253,205,181,253,194,240,1,2575
1040 DATA 33,240,253,22,21,213,229,215,32,0,225,209,119,35,21,1867
1050 DATA 202,240,1,205,196,253,202,240,1,254,44,32,233,215,32,2350
1060 DATA 0,215,48,37,32,22,215,24,0,205,196,253,204,183,5,1639
1070 DATA 215,251,36,254,44,196,183,5,215,32,0,24,243,205,160,2063
1080 DATA 253,42,8,254,58,69,92,119,35,58,70,92,119,35,58,1362
1090 DATA 71,92,60,119,42,83,92,30,42,215,134,29,218,202,253,1682
1100 DATA 62,1,146,50,68,92,215,119,0,215,24,0,254,68,32,1346
1110 DATA 30,6,6,215,32,0,16,251,33,240,253,229,215,32,0,1558
1120 DATA 225,86,35,186,32,10,122,254,44,32,241,215,32,0,24,1538
1130 DATA 10,215,32,0,205,196,253,32,248,24,192,215,24,0,205,1851
1140 DATA 196.253.40.45.215.31.28.205.153.253.205.174.253.215.86.2352
1150 DATA 28,205,160,253,205,167,253,215,24,0,254,44,32,20,215,2075
1160 DATA 32,0,205,153,253,205,174,253,215,32,0,205,160,253,205,2345
1170 DATA 167,253,24,211,205,174,253,215,24,0,205,196,253,194,207,2581
1180 DATA 253,42,8,254,35,35,35,34,8,254,58,10,254,60,50,1390
1190 DATA 10,254,254,151,202,212,253,195,193,5,33,226,253,205,181,2627
1200 DATA 253,194,240,1,22,21,213,215,32,0,209,21,202,240,1,1864
1210 DATA 205,196,253,202,240,1,254,44,32,237,215,32,0,215,48,2174
1220 DATA 37,32,25,215,24,0,205,196,253,204,183,5,215,31,28,1653
1230 DATA 215,24,0,254,44,196,183,5,215,32,0,24,240,215,32,1679
1240 DATA 0,205,196,253,194,90,253,195,193,5,33,233,253,205,181,2489
1250 DATA 253,194,240,1,215,32,0,205,183,5,58,10,254,254,0,1904
1260 DATA 202,217,253,61,50,10,254,42,8,254,43,126,50,68,92,1730
1270 DATA 43,126,50,67,92,43,126,50,66,92,34,8,254,195,193,1439
1280 DATA 5,42,93,92,34,4,254,201,42,93,92,34,6,254,201,1447
1290 DATA 42,4,254,34,93,92,201,42,6,254,34,93,92,201,229,1671
1300 DATA 215,32,0,225,86,35,186,192,126,254,0,200,24,241,254,2070
1310 DATA 13,200,254,58,201,253,54,0,24,239,253,54,0,25,239,1867
1320 DATA 253,54,0,15,239,253,54,0,6,239,82,79,67,0,69,1410
1330 DATA 70,80,82,79,67,0,78,68,80,82,79,67,0,0,0,832
```

LISTING 3

```
  10 REM DEMONSTRATION PROGRAM
  20 REM  SPECTRUM PROCEDURES
  30 REM      By David Hales
  40 REM
  50 RANDOMIZE USR 64500
 100 *PROC SET-UP,
 200 *PROC MENU,
 300 *PROC CHOICE,1,3
 305 CLS
 310 IF CHOICE=1 THEN *PROC VARS,
 320 IF CHOICE=2 THEN *PROC SOUND,
 330 IF CHOICE=3 THEN *PROC EXIT,
 335 CLS
 340 GO TO 200
7900 REM
7910 REM DEFINITIONS
7920 REM
7930 REM
8000 *DEFPROC WAIT KEY,
8010 PRINT #0;"   PRESS ANY KEY TO CONTINUE"
8020 PAUSE 0
8030 CLS
8040 *ENDPROC
8050 REM
8060 REM
8100 *DEFPROC CENTRE,S$
8110 IF LEN S$>32 THEN  CLS : PRINT "STRING TOO LONG TO CENTRE": STOP
8120 PRINT TAB (32-LEN S$)/2;S$
8130 *ENDPROC
8140 REM
8150 REM
8200 *DEFPROC CHOICE,LOW,HIGH
8210 PRINT : PRINT
8220 *PROC CENTRE,"PRESS THE KEY NEXT"
8230 *PROC CENTRE,"TO YOUR CHOICE"
8240 *PROC GET NUMBER,
8250 IF NUMBER>HIGH OR NUMBER<LOW THEN  GO TO 8240
8260 LET CHOICE=NUMBER
8270 *ENDPROC
8280 REM
8290 REM
8300 *DEFPROC GET NUMBER,
8305 LET I$=INKEY$
8310 IF I$>"9" OR I$<"0" THEN  GO TO 8305
8320 LET NUMBER=VAL I$
8330 *ENDPROC
8340 REM
8350 REM
8400 *DEFPROC VARS,
8410 *PROC CENTRE,"SYSTEM VARIABLES:-"
8420 PRINT : PRINT
8430 PRINT "ADDRESS OF CHARACTER SET:";:*PROC DEEK,23606
8435 PRINT
8440 PRINT "ADDRESS OF BASIC PROGRAM:";:*PROC DEEK,23635
8445 PRINT
8450 PRINT "ADDRESS OF VARIABLES    :";:*PROC DEEK,23627
8455 PRINT
8460 PRINT "CURRENT VALUE OF RAMTOP :";:*PROC DEEK,23730
8470 *PROC WAIT KEY,
8480 *ENDPROC
8490 REM
8495 REM
8500 *DEFPROC DEEK,ADDRESS
8510 PRINT PEEK ADDRESS+256*PEEK (ADDRESS+1)
8520 *ENDPROC
8530 REM
8540 REM
8600 *DEFPROC SOUND,
8610 BEEP 1,0
8620 *PROC CENTRE,"THAT'S IT!"
8630 *PROC WAIT KEY,
8640 *ENDPROC
8650 REM
8660 REM
8700 *DEFPROC EXIT,
8710 *PROC CENTRE,"TO RE-START, TYPE ""RUN"""
8720 *PROC WAIT KEY,
8730  STOP
8740 REM
8750 REM
9000 *DEFPROC SET-UP,
9010  BORDER 0: PAPER 0: INK 7: CLS
9020 *PROC CENTRE,"PROCEDURE DEMONOSTRATION PROGRAM"
9030 PRINT
9040 *PROC CENTRE,"By David Hales"
9050 PRINT : PRINT
9060 PRINT "This program should give you an"
9065 PRINT
9070 PRINT "example as to how the procedure"
9075 PRINT
9080 PRINT "commands should be used."
9100 *PROC WAIT KEY,
9110 *ENDPROC
9120 REM
9130 REM
9500 *DEFPROC MENU,
9510 *PROC CENTRE," PROCEDURE DEMONOSTRATION MENU"
9520 PRINT : PRINT
9530 *PROC CENTRE,"YOUR OPTIONS ARE:-"
9540 PRINT : PRINT
9550 PRINT "(1) LOOK AT SYSTEM VAIRABLES"
9555 PRINT
9560 PRINT "(2) MAKE A SOUND"
9565 PRINT
9570 PRINT "(3) RETURN TO BASIC"
9580 *ENDPROC
```

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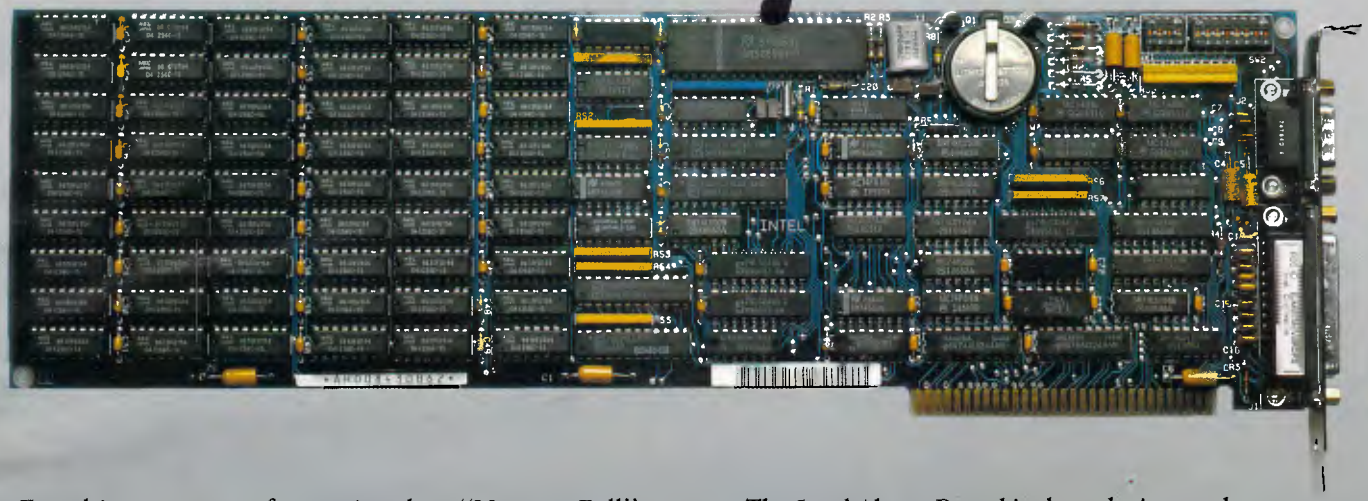

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